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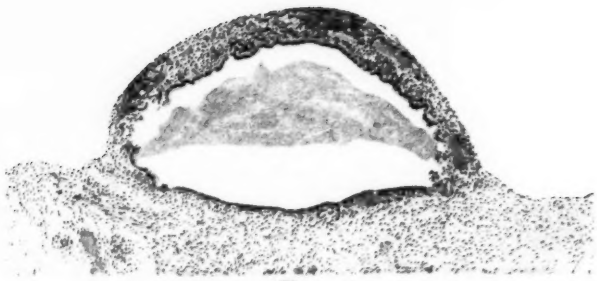
Fig. 3



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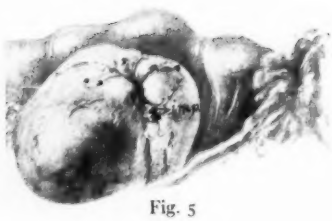

Fig. 5

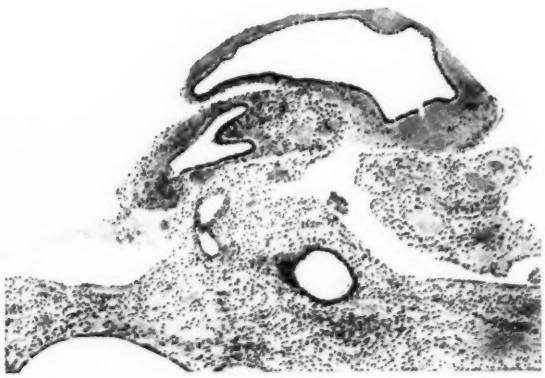

Fig. 6

Fig. 8

Fig. 10

PLATE I.—(See legends on opposite page.)

Benign and Malignant Endometrial Implants in the Peritoneal Cavity.—John A. Sampson

SURGERY, GYNECOLOGY AND OBSTETRICS

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BENIGN AND MALIGNANT ENDOMETRIAL IMPLANTS IN THE PERITONEAL CAVITY, AND THEIR RELATION TO CERTAIN OVARIAN TUMORS

BY JOHN A. SAMPSON, M.D., F.A.C.S., ALBANY, NEW YORK

From the Gynecological and Pathological Departments of the Albany Hospital and of Union University (Albany Medical College)

THE surgeon has a wonderful opportunity to study "living pathology" in both the early and the advanced stages of disease, which unfortunately the pathologist, working in the laboratory, rarely sees, except in experimental work on the lower animals. Two questions should arise in the mind of the surgeon observing a patient with a new-growth of any kind. First, what is the nature of the tumor, and secondly, how did the condition present arise? He has a responsibility and likewise an opportunity both to try to relieve the patient and also to increase his knowledge of the subject. His first duty is to the patient, but the attempt to increase his knowledge of "living pathology" need not necessarily interfere with the welfare of individual patients, and the sum total of his observations may be of great value both to the patient under observation and also to others.

When a surgeon cures, or even temporarily relieves, a patient with a malignant growth, he rejoices. If the operation or treatment is followed by an extension of the growth greater than the natural course of the disease, he

PLATE I

Fig. 3. The left tube and ovary shown in Figure 2 with an implant on the suspensory ligament of the ovary (natural size). The "red raspberry" appearance of the implant is due to a recent hæmorrhage; for its histological structure see Figure 4.

Fig. 4. Colored photomicrograph (×60) of a section of the implant shown in Figure 3 (hæmatoxylin and eosin stain). It is similar to a dilated uterine gland with a vascular stroma, resembling that of the endometrium, about it. Hæmorrhage has occurred into its lumen. For the latter phase of such an implant see Figure 9, *b*.

Fig. 5. (A. H. No. 88156.) Right tube and ovary, the latter turned upward showing implants on its lateral surface (natural size). Implants were present on both ovaries, the posterior surface of the uterus, and the sigmoid, including one of its epiploic appendages. For histological structure of the implants on the surface of the right ovary, and the invasion of the epiploic appendage, see Figures 6, 42, and 44. The patient's age was 47. She had had one child 21 years ago. The uterus was retroflexed. Operation was on the day after menstruation had ceased. The distribution of these implants suggests a common origin and could be accounted for by epithelium escaping through the tubes.

Fig. 6. Colored photomicrograph (×60) of a section through one of the implants shown in Figure 5. Hæmorrhage is present in the tissues about the glands and the latter have invaded the ovary.

Fig. 8. Under surface of the right ovary shown in Figure 7. The implants are larger than those illustrated in Figures 3 and 5 and have a "purple raspberry" appearance (natural size).

Fig. 10. (A. H. No. 89961.) Endometrial implants in the cul-de-sac fusing the anterior wall of the rectum to the posterior wall of the cervix uteri (natural size; from colored sketch made at the operation). The pigmented areas with "blueberry" coloring are due to an older hæmorrhage about or into the endometrial tissue than that shown in Figures 3, 5, and 8. Similar implants were present on the under surface of both ovaries. The patient was 37 years old, single; the uterus was retroflexed, and the induration in the cul-de-sac caused by the implantation was easily detected prior to the operation. Operation was 6 days after the last menstrual flow.

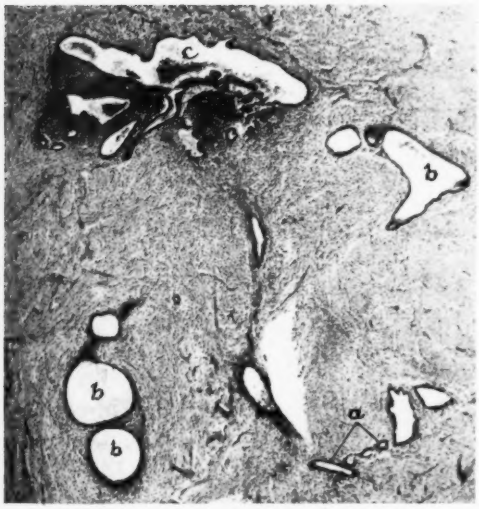

Fig. 1. Photomicrograph (×25) of a section of a small nodule found in the scar of an abdominal incision after three abdominal operations, one of which was a cæsarean section. This afforded the opportunity of implanting endometrial tissue in the abdominal wound. (Slide sent to me by Dr. F. B. Mallory, of Boston, from a specimen removed by Dr. F. L. Good.) Glands, *a*, with stroma about them similar to those of the normal endometrium, and also dilated glands, *b*, with "flattening" of the epithelium are present, and even a miniature endometrial cavity, *c*.

Similar structures are also present in the so-called adenomyomata arising from the invasion of the uterine wall by its mucosa, and in the endometrial implants found on the surface of the ovaries and on the other structures in the pelvis. I believe the latter arise primarily from tissue escaping from the uterine cavity through the tubes during menstruation, and possibly occasionally from portions of the tubal mucosa which have reacted to menstruation (see text and other illustrations).

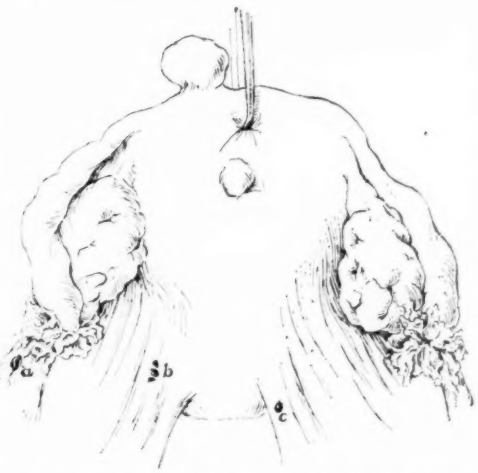

Fig. 2. (A. H. No. 89183.) Endometrial implants on the suspensory ligament of the left ovary, *a*, on the broad ligament near the uterine attachment of the left uterosacral ligament, *b*, and on the right uterosacral ligament, *c* (×⅗). The patient's age was 33 years. She had never had any children, but had a miscarriage 9 years ago. Operation was on the first day of the menstrual period. The uterus was retroflexed and contained several small leiomyomata. The implants (*a* and *c*) are superficial, similar, and apparently of the same age. Implant *b* is apparently older (thus representing an earlier implantation) and had invaded the underlying tissue. The distribution of the implants suggests a common origin. Epithelium escaping through the tubes could have caused them. For the appearance of and the histological structure of the implant *a*, see Figures 3 and 4.

should not only regret the unfortunate result, but should also attempt to determine in what way he may have been responsible.

The material upon which this communication is based was primarily studied in an attempt to determine the origin of benign implantation adenomata of endometrial type (endometrial implants). I believe that the by-products of this investigation are of as great pathological interest and clinical importance as the original subject. It is my purpose not only to review the origin and distribution of benign endometrial implants from epithelium escaping through the fallopian tubes, but also to show (a) that cells from malignant tumors of the endometrium may at times escape through the tubes before operation, (b) that malignant implants apparently arise from this source, and (c) that they resemble in their distribution the benign endometrial implants and may also give rise to ovarian tumors. I shall also demonstrate that the manipulation of the uterus before and during operation may at times cause endometrial tissue to escape from the uterine cavity through the tubes into the peritoneal cavity.

Pathological conditions arising from the implantation of tissue (including epithelium) which escapes from or through the fallopian tubes into the peritoneal cavity probably furnish the most frequent pelvic lesions found at operation in women between the ages of 30 and the menopause. I encountered 37 patients with these lesions during the year May 1, 1921, to May 1, 1922, (representing a little less than 11 operative months), in 170 ab-

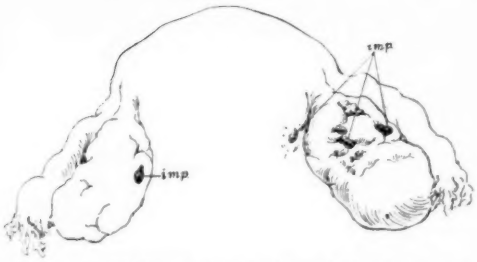

Fig. 7. (A. H. No. 87866.) Endometrial implants, *imp.*, on the under surface of both ovaries and on the posterior surface of the right broad ligament near its uterine attachment. Posterior view of the uterus, tubes, and ovaries, the latter turned upward in order to show the implants (×½). (See Figs. 8 and 9.) The patient's age was 38. She had had one child 12 years ago. The uterus was retroflexed. Operation was at the onset of the menstrual period.

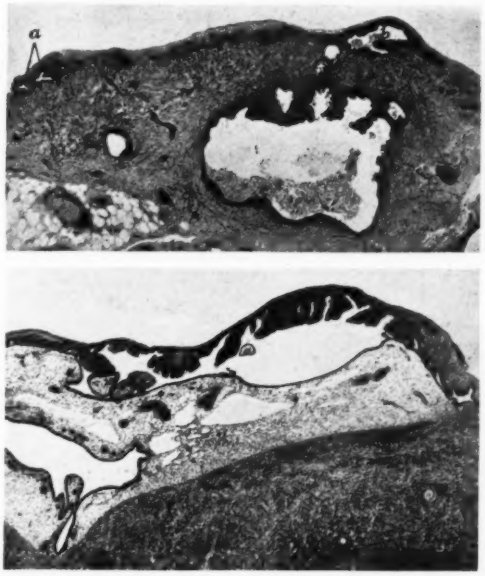

Fig. 9. Photomicrographs (× 25) of a section of the implant on the posterior surface of the broad ligament and also of one of those on the surface of the right ovary shown in Figures 7 and 8. At *a*, a small (young) implant is indicated and at *b* an older one, both on the surface of the broad ligament. Implant *b* has invaded the underlying tissues developing into a miniature "endometrial cavity." (Compare with Fig. 1.) The implant on the surface of the ovary (the lower photomicrograph) presents a condition somewhat similar to that shown at *b*.

dominal operations for pelvic disease in women between 30 and 50 years of age, and 6 additional cases, 3 under 30 years of age and 3 over 50. During the year May 1, 1922, to May 1, 1923, (also representing a little less than 11 operative months) 64 patients with these lesions were encountered in 296 operations similar to the above. Of the patients between 30 and 50 years of age, the lesion was found 52 times in 198 operations; of those under 30, 9 times in 59 operations; and of those over 50, 3 times in 39 operations. The youngest patient in these two series was 22 years old.

As previously stated (1), should the tissue escaping through the fallopian tubes into the peritoneal cavity fall on suitable soil, it would develop into glands or tubules of endometrial type, which usually react to menstruation. These endometrial implants are most frequently found on the pelvic structures which would naturally be reached by material escaping through the tubes, as both the pelvic peritoneum and the lateral and under surfaces of the ovaries, or only the pelvic peritoneum, or only the ovaries. Pigmentation due to hæmorrhage (menstruation) is nearly always present in the tissues of these implants and this, with their other features (Figs. 3, 5, 8, 10, 13, 14, and 16), permits them to be easily recognized at operation.

The primary peritoneal implants are usually small and are easily overlooked by the operator who is not familiar with them. However, they sometimes spread and become invasive. The implants on the ovary are usually much more active than those lodged on the peritoneum and often invade the tissues of that organ. As a result of their growth combined with their reaction to menstruation they frequently develop into superficial or deep hæmatomata (hæmorrhagic menstruating or "chocolate" cysts) of endometrial type. Perforation often occurs in the superficial hæmorrhagic cysts while they are still small, a few millimeters in diameter. The hæmorrhagic cysts developing in the deeper tissues of the ovary may reach several centimeters in size (the largest one observed was about 15 centimeters in diameter). Repeated perforations may occur. Many interesting histological changes occur in the wall of the ovarian hæmatomata in their reaction to menstruation (Figs. 19 and 20) and the at-

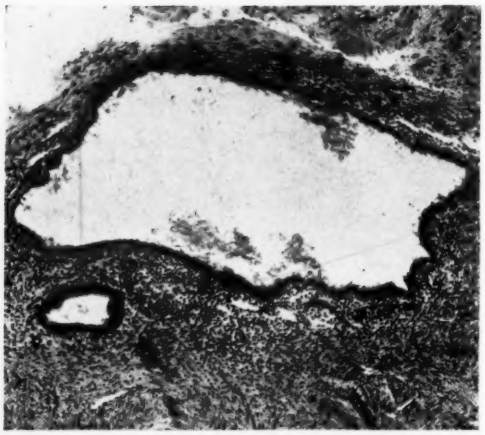

Fig. 11. Photomicrograph (×60) of a section through one of the pigmented elevations shown in Figure 10. It consists of typical endometrial tissue with a normal-sized and a dilated gland. Hæmorrhage is present in the tissues about the glands and likewise in their lumina, causing the pigmented appearance shown in Figure 10.

tempted epithelial repair following it. As this repair is attended with difficulty the usual ultimate tendency of these cysts is one of retrogression.

Any endometrial implant, wherever situated, may not only invade the tissues on which it primarily develops, but may also invade adjacent structures with which it comes in contact. In the reaction to menstruation epithelium may also be cast off and give rise to other implants. The perforation of the

Fig. 12. (A. H. No. 88416.) Condition found at operation in a patient with multiple leiomyomata and endometrial implants on the surface of both ovaries, the posterior surface of the uterus, the terminal loop of the ileum, and the sigmoid (×⅔). An ovarian hæmatoma of endometrial type, 2 centimeters in diameter, was present in the left ovary, which possibly had perforated. It is impossible to state whether all the implants were primarily derived from epithelium escaping through the tubes, or whether some may have arisen from other implants, especially from perforation of the ovarian hæmatoma. The patient was 37 years old, married, but had never been pregnant. The operation was 2 weeks after the last menstrual flow.

Plate II

Fig. 13. Left tube and ovary (shown in Fig. 12), the ovary turned upward exposing its lateral surface (natural size). The pigmentation ("blueberry" coloring) is due to hæmorrhage in the endometrial tissue implanted on the surface of the ovary. The position of the fimbriated end of the patent tube, which was adherent to the lateral surface of the ovary, indicates a source for these implants, namely epithelium escaping through the tube. For the histological structure of some of these implants see Figure 15.

Fig. 14. Endometrial implants on the terminal loop of the ileum shown in Figure 12, from sketch, natural size, made at the operation. These were not excised, but were identical in their appearance with those situated on the ovaries which were examined microscopically. Compare also with Figure 32, showing the implants on the small intestine from a malignant tumor of the endometrium.

Fig. 15. Colored photomicrograph (×25) of a section through the implants on the surface of the ovary shown in Figure 13. These consist of glands of endometrial type with evidence of old and recent hæmorrhage in the tissue about them. The glands have invaded the tissues of the ovary and a small endometrial cyst is present at the left which, I believe, arose from these glands as did also the hæmatoma or hæmorrhagic cyst of the same ovary (left) shown in Figure 12.

Fig. 16. (A. H. No. 89902.) A portion of the lateral surface of the right ovary with pigmented elevations on its surface due to hæmorrhage into the tissues of an endometrial implant (natural size). The fresh hæmorrhage (red) is due to trauma from the manipulations of the operation. The patient was 29 years old, single; the uterus was greatly enlarged due to multiple leiomyomata. Implants were present on the surface of both ovaries and in the cul-de-sac. The right ovary contained a hæmatoma of endometrial type about 4 centimeters in diameter, which had perforated. Operation was 2 weeks after the last menstrual flow. For the histological structure of the implant see the next illustration.

Fig. 17. Colored photomicrograph (×25) of a section through the implant, taken from the right ovary, shown in Figure 16. Endometrial tissue is present with normal-sized and dilated glandular spaces and old and recent hæmorrhage in the tissues about the glands and in the lumina of the same.

Fig. 13

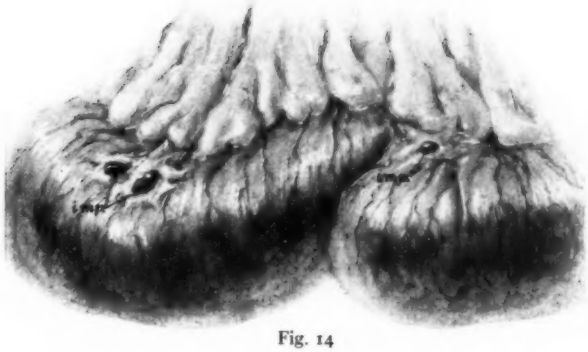

Fig. 14

Fig. 15

Fig. 16

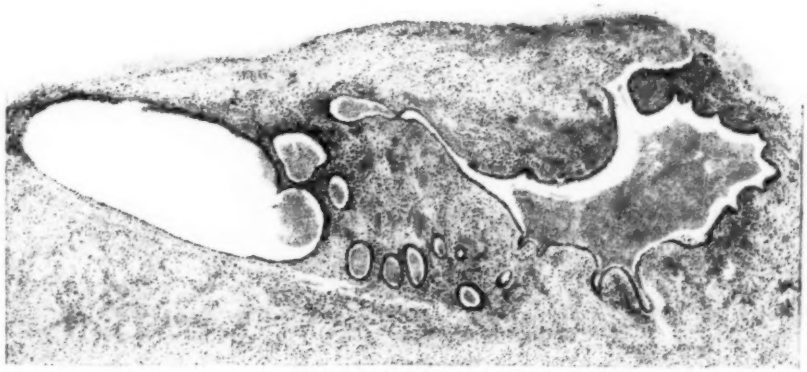

Fig. 17

PLATE II.—(See legends on opposite page.)

Benign and Malignant Endometrial Implants in the Peritoneal Cavity.—John A. Sampson

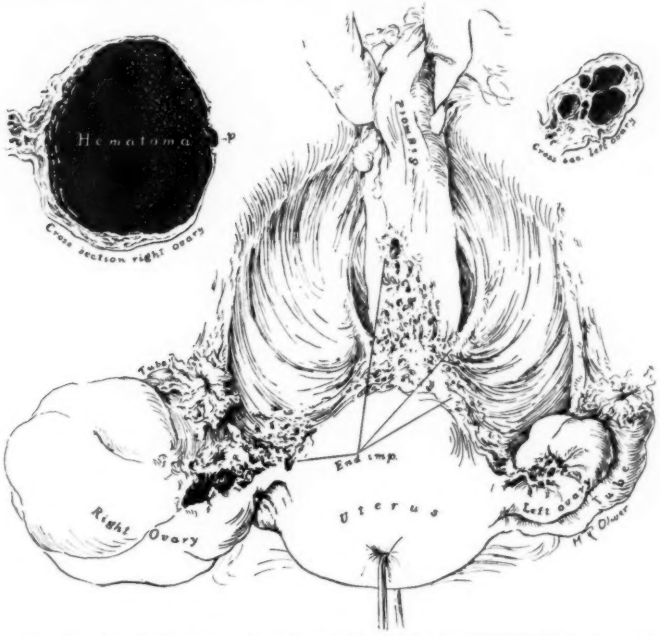

Fig. 18. (A. H. No. 86449.) A large endometrial hæmatoma (about 6 centimeters in diameter) of the right ovary, with evidence of a previous perforation, *p*, multiple small endometrial hæmatomata of the left ovary, also endometrial implants invading the posterior surfaces of both broad ligaments, the uterus, and the anterior wall of the rectosigmoid, fusing the uterus with the latter. The condition found at the operation, after freeing the ovaries and partially separating the uterus from the large intestine (×¾).

I believe that the ovarian hæmatomata arose from epithelium escaping through the tubes, becoming implanted on the surface of the ovaries, invading them, and developing into menstruating endometrial cysts. The implants on the surface of the broad ligaments, the uterus, and the large intestine, may have been derived primarily from epithelium escaping through the tubes, or from the perforation of the ovarian hæmatoma. The ovarian hæmatoma may be considered as a hot bed or a redistributing focus in the origin of these implants. The uterus contained multiple leiomyomata and an endometrial polyp. The patient was 47 years old, married, but never pregnant; the operation was just before the next menstrual flow. (See Figs. 19, 20, and 21.)

ovarian hæmatomata, whether small or large, is apparently the chief source of these secondary growths. The ovary may be considered an incubator, hot bed, redistributing focus, or even intermediary host in the origin of these secondary implants, which, in some instances, may possibly impart greater activity (virulence) to the epithelium developing in it. This latter faculty, while apparently present, is difficult to estimate, as there is such a great variation in the degree of invasiveness of the implants in different cases. Many are small and chiefly of histological interest, while others may simulate malignancy in both their clinical and gross pathological manifestations. In some instances only primary implants are present, while in others these are both primary and secondary. When an ovarian hæmatoma is present, with evidence of a previous perforation, and is associated with adhesions and an endometrial invasion of the tissues involved in these adhesions, the endometrial tissue of the latter would seem to have arisen from epithelium carried with the contents of the hæmatoma escaping through the perforation (Figs. 18 and 21).

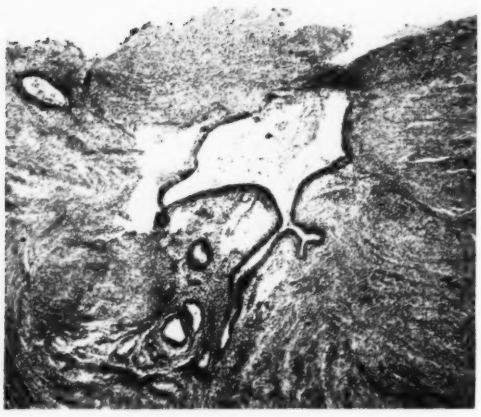

Fig. 21. Photomicrograph (×60) of a section of a portion of the posterior uterine wall (Fig. 18). Typical endometrial tissue has invaded the uterine wall causing a so-called adenomyoma of the uterus, from endometrial tissue implanted on the peritoneal surface of that organ. This implant was derived either from tissue escaping through the tubes as a primary growth, or as a secondary one from the perforation of the ovarian hæmatoma.

The distribution of the implants in these cases is similar to that associated with malignant ovarian tumors, except that the latter are usually much more extensive. I have never found benign endometrial implants in the omentum, which is so often involved in patients with peritoneal carcinosis.

This series of 64 cases of endometrial implantation and the conditions arising from them admits of the following classification:

1. Small implants involving both the surface of the ovary or ovaries and the other structures in the pelvis (18 cases). The implants involving the ovaries were usually found on their lateral and under surfaces (Figs. 5, 8, and 13). Those on the peritoneum were usually multiple and most often on the posterior surface of the uterus, the broad ligaments, and in the cul-de-sac, especially about the uterine attachment of the uterosacral ligaments (Figs. 2, 7, and 10). They were also encountered on all the structures in the pelvic cavity excepting the omentum and the bladder.

2. Small implants on the structures in the pelvis similar to those just mentioned, but without any demonstrable ovarian lesion (18 cases).

3. Small implants on the surface of the ovary or ovaries, without any evident peritoneal involvement (9 cases).

4. Ovarian hæmatomata from 5 millimeters to 15 centimeters in diameter (18 cases). The majority of these had apparently perforated and were adherent at the site of perforation to various adjacent structures. They were also associated with other adhesions apparently resulting from the escape of the contents of the hæmatoma into the pelvic cavity. Furthermore there was usually peritoneal implantation of greater extent and a deeper endometrial invasion of the underlying structures than in the previous groups (Fig. 18). In one case the perforation had extended through the posterior layer of the right broad ligament, to which the ovarian hæmatoma was adherent, and endometrial tubules were found invading the tissues between the layers of the broad ligament. An "adenomyoma" was present in the groin in this case. It was attached to the round ligament of the same side as the ovarian hæmatoma, suggesting that the endometrial tissue had reached the groin through the round ligament by metastasis or direct extension. Another instance of "adenomyoma" in the groin was found, but without demonstrable implantation lesions in the pelvis.

Intestinal implants were present in 13 patients. The rectosigmoid was invaded in 11, the sigmoid and small intestine in 1, and the cæcum in another instance. The appendix was not found involved in this series of cases, as in previous ones. Of the 45 cases in which ovarian lesions were present, both ovaries were involved in 18.

All of the ovarian lesions were examined microscopically, the ovary or ovaries having been removed or the area involved excised. In every instance in which peritoneal implants were found, a specimen was examined microscopically, but all implants were not removed in every instance. Only two of the intestinal implants were removed, both in epiploic appendages of the sigmoid. In the other cases the intestinal lesions were of a gross appearance corresponding with that of the other peritoneal implants which were present and were removed. In no instance did I think that

intestinal resection or excision of a piece of the wall of the intestine was justifiable.

The life history (1) of the ovarian hæmatomata, the intestinal lesions (2) resulting from endometrial implants, and the clinical features (3 and 4) of these conditions, have been discussed in previous papers. Further studies have strengthened the views expressed in these articles, with minor changes resulting from a better knowledge of the subject.

THE ORIGIN OF ENDOMETRIAL IMPLANTS

The microscopic study of menstrual blood shows that it may sometimes contain not only epithelium cast off by menstruation, but also bits of endometrial stroma. Occasionally blood may be observed escaping from the fimbriated ends of the fallopian tubes of patients operated upon during the menstrual period. The question naturally arises: Does this blood come from a back-flow from the uterine cavity or from portions of the tubal mucosa which have reacted to menstruation? I believe that it may arise from both sources, but more frequently from the uterine cavity. The reaction of tubal mucosa to menstruation, giving rise to an appreciable flow of blood, is probably infrequent, otherwise hæmatosalpinx would be a more common condition as compared with hydrosalpinx. Irrespective of the source of the blood (whether uterine or tubal), which escapes into the peritoneal cavity at this time, we know that it may contain epithelium cast off by the menstrual process. I have found epithelium both in the lumen of the tube and in blood escaping from it.

The primary endometrial implants are most often found on the structures in close anatomical contact with the fimbriated ends of the tubes, and less frequently on more remote structures which would not as readily be reached by blood escaping through the tubes into the peritoneal cavity, as has already been discussed. All this is circumstantial evidence as to the primary origin of these implants. The one positive proof that endometrial tissue may become implanted and grow in human beings is the development of "adenomyomata" in the scar of the abdominal incision, after operations in which the uterine cavity has been opened. I have referred to two such instances in a paper (1) presented by me at the meeting of the American Gynecological Society in 1922. The specimens from these two cases had been examined by Dr. F. B. Mallory, of Boston, Massachusetts. In the discussion of my paper, Dr. T. S. Cullen (5) reported through Dr. C. F. Burnam three cases of adenomyoma in the scar of an abdominal incision. "One of these cases followed an extensive operation for an adenomyomatous uterus and adenomyoma of the rectovaginal septum 8 years after the original operation. The other two cases followed ordinary cæsarean section, one of them belonging to Dr. Albert L. Stavely, of Washington, and one to Dr. Ernest A. Codman, of Boston. The first case shows that it is possible to transplant adenomyoma and the other two indicate that ordinary uterine mucosa implanted into an abdominal incision can grow into a tumor

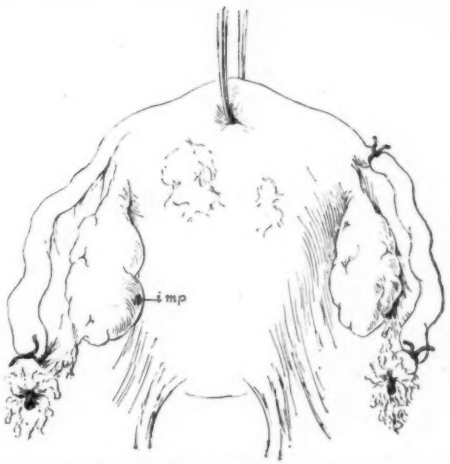

Fig. 22. Patient (A. H. No. 88663.) age 44, single, gave a history of very profuse menstruation and a previous curettage, with only temporary relief. The uterus was found to be irregularly enlarged and retroflexed. The patient was flowing at the time of the operation and blood could be seen escaping through the fimbriated end of both tubes. At the beginning of the operation the fimbriated end of the left tube, and both the fimbriated and the uterine ends of the right tube were ligated (illustration ½ natural size). The uterus, left tube and ovary, and the right tube were removed and hardened in formalin. Sections made from both tubes showed blood and epithelial cells; a greater amount was found in the left tube, as would be expected. An endometrial implant, *imp.*, was present on the under surface of the left ovary. For the histological structure of the uterine mucosa, the contents in the left tube, and of the endometrial implant on the ovary, see Figures 23, 24, and 25.

exactly like adenomyoma." In October, 1922, Dr. Mallory sent me sections from a third case which had come under his observation. The specimen had been removed by Dr. Frederick L. Good, of Boston. Through the courtesy of Drs. Good and Mallory, I am including a brief report of this interesting case.

Mrs. R., age 30, had had three operations before coming under Dr. Good's care. The first was a cæsarean section in 1913, by Dr. Sleeper, of Dorchester; the second, a left salpingectomy in 1915 for tubal pregnancy, by Dr. Cotter, of Boston; and the third a supravaginal hysterectomy in 1917 by Dr. Peer Johnson, of Beverly. The patient noticed a small nodule in the abdominal scar a few weeks after the last operation. This nodule gradually increased in size, but never caused any pain or discomfort. It was removed by Dr. Good, September 15, 1922. A photomicrograph of a section of this nodule is shown in Figure 1. It contains the typical endometrial tissue of an "adenomyoma" such as arises from the invasion of the uterine wall by the mucosa lining its cavity.

Dr. Victor C. Jacobson (6) has experimentally proved, in the pathological laboratory of the Albany Hospital and the Albany Medical College, that bits of the uterine mucosa of the rabbit may be transplanted and give rise to growths in many ways similar to the endometrial implants already described. These experiments strengthen the clinical observations as to the origin of these growths in human beings.

I believe that the evidence that these implants may primarily arise from epithelial cells escaping from or through the tubes during menstruation is as conclusive as that for the origin of any pathological condition in the human body. My present reaction is that they arise more frequently from the uterine mucosa. The facts in proof of this belief may be thus summarized.

1. They are of frequent occurrence (64 instances in 296 abdominal operations for pelvic conditions in one year).

2. They apparently develop during the menstrual life of women and are most frequently found in patients between thirty years of age and the menopause.

3. The histological structure of the endometrial elements in these implants, including the incidence of ciliated epithelium, is identical with that found in the invasion of the uterine wall by the mucosa lining its cavity.

4. The tubes are usually patent and even though occluded the implantation could have occurred before the tubes became closed.

5. The uterus in these patients is often retroflexed, or contains leiomyomata and polyps, conditions which might sometimes favor a back-flow of menstrual blood through the tubes.

6. Occasionally blood may be observed escaping from the fimbriated ends of the tubes

PLATE III

Fig. 19. Colored photomicrograph (×130) of a section of a portion of the cyst wall of the large hæmatoma of the right ovary shown in Figure 18. This portion of the cyst wall is lined by columnar epithelium. An extensive subepithelial hæmorrhage is present, which in places is bursting through the epithelial lining and carrying with it into the cavity of the cyst the overlying epithelium. Perforation of the cyst would permit its contents, including epithelium, to escape into the pelvis. The cyst had perforated and implants were present in situations where the contents had evidently escaped into the peritoneal cavity, see Figures 18 and 21.

Fig. 20. Colored photomicrograph (×25) of a portion of the wall of one of the hæmatomata shown in the left ovary of Figure 18. To the right the cyst wall is lined by columnar epithelium with an underlying vascular stroma similar to that of the endometrium. To the left the epithelium has been cast off and the stroma is replaced by a pigmented lining consisting of phagocytic cells containing hæmosiderin (positive reaction to iron).

Fig. 23. Colored photomicrograph (×60) of a section of a portion of the uterine mucosa showing that some of the surface epithelium had been cast off by menstruation. The blood, present in the uterine cavity at the time of the operation, escaped on incising the uterus (Fig. 22). Could any of it have passed into the tubes, prior to or during the operation? (See Fig. 24.)

Fig. 24. Colored photomicrograph (×60) showing endometrial tissue in the lumen of the left tube. Blood is present and free-lying bits of epithelium similar to the epithelium shown in Figure 23, and also stroma identical with that of the endometrium. Many sections were studied from different portions of both tubes, and in all the tubal mucosa was intact. The blood found escaping through the fimbriated ends of the tubes was due to a backflow from the uterine cavity and took with it bits of endometrial tissue.

Implants of endometrial tissue are found on pelvic structures which would naturally be soiled by blood escaping from the tubes. The presence of endometrial growths in the abdominal scar after cæsarean section (see text and Fig. 1) shows that this tissue will sometimes grow when unintentionally transplanted by the surgeon.

Fig. 25. Colored photomicrograph (×60) of the endometrial implant on the surface of the right ovary (Fig. 22). The epithelium and stroma about it are similar to that of the endometrium (Fig. 23), and also to that found lying free in the lumen of the tube (Fig. 24). It occurs in a place easily contaminated by material escaping through the fimbriated end of the tube. I believe that the source of this implant is indicated in Figures 23 and 24.

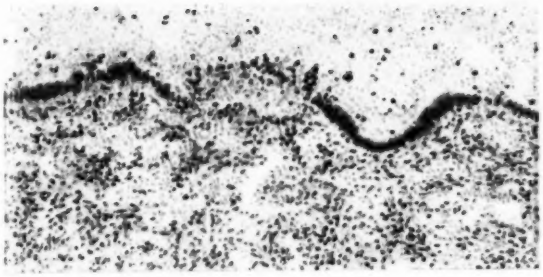

Fig. 19

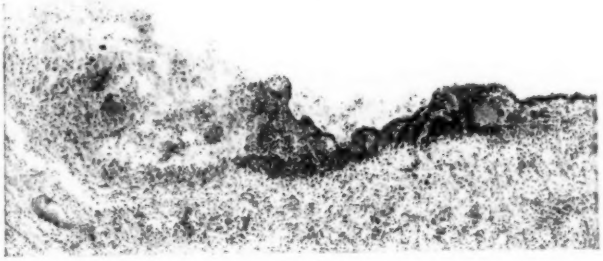

Fig. 20

Fig. 23

Fig. 24

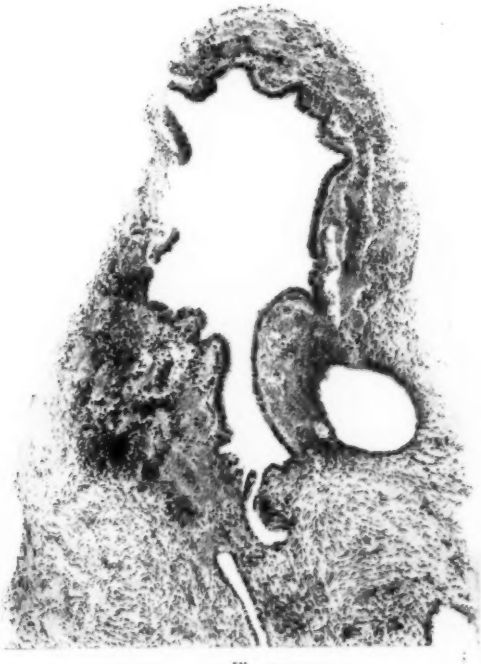

Fig. 25

PLATE III.—(See legends on opposite page.)

Benign and Malignant Endometrial Implants in the Peritoneal Cavity.—John A. Sampson

of patients operated upon during menstruation (Fig. 22). The microscopic examination of this blood may show epithelial cells. The histological study of sections of the tubes may also show epithelium and bits of endometrial stroma lying free in the lumen of the tube (Fig. 24).

7. As the study of ectopic endometrial tissue in the pelvis demonstrates that implants may sometimes arise from this, it is natural to assume an implantation origin for the former, if a source could be found. Menstrual blood escaping through the tubes indicates a source.

8. They are often found in different stages of development in the same individual, thus suggesting repeated implantations from the original source or from other implants.

9. The early implants are found on structures in the pelvis which would naturally be reached by blood escaping through the tubes and they are most frequent on the structures in close anatomical relation with the fimbriated ends of the tubes. They may be present only on the peritoneum or only on the ovaries, but are usually found on both. Their distribution is often bilateral, as occurs in pelvic inflammatory lesions of tubal origin.

10. Similar growths have been observed in the scar of the abdominal incision of patients in whom the uterine cavity has been opened, thus affording the opportunity of implanting bits of uterine mucosa in the tissues of the abdominal incision.

11. Jacobson has reproduced lesions similar in many respects by the auto-transplantation of bits of the uterine mucosa of the rabbit into the tissues of the pelvis.

The question naturally arises, what are the conditions which would favor the escape of menstrual blood from the uterine cavity through the tubes? This would readily occur in women with patent tubes of large caliber, especially in the interstitial portion of the tubes, when the uterus was relaxed and when there was any interference with the escape of menstrual blood through the cervix. The damming back of menstrual blood in the uterine cavity might be caused by many conditions, such as clots of blood and pieces of tissue occluding the cervical canal, and possibly by retroflexion of the uterus, and leiomyomata and polyps which encroach upon the uterine cavity. Reverse uterine contractions might force the fluid contents of the uterine cavity into the tubes. Probably a very important factor is a large caliber of the interstitial portion of the fallopian tubes. This varies greatly in different women and also probably in the same individual under different conditions. During the years 1916 and 1917 I was greatly interested in the shape of the uterine cavity in normal and pathological conditions. This was determined by injecting melted gelatine containing bismuth subcarbonate or barium sulphate in suspension through the cervix of the uterus removed at operation, or obtained at autopsy. After the solution had become solidified, by placing the specimen in cold water, X-rays of it were

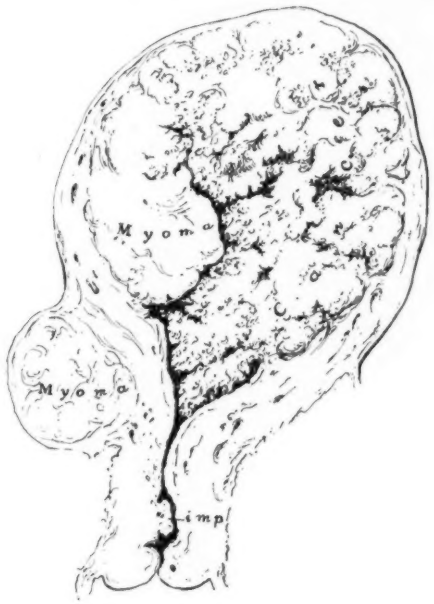

Fig. 26. Sagittal section of a uterus with extensive adenocarcinoma of the body and multiple leiomyomata. (×⅔.) Case 1. Carcinoma was also present in the left tube either as a primary growth or secondary to that of the uterus, from bits of cancer escaping from the uterine cavity into the lumen of the tubes and becoming implanted on the tubal mucosa. (Figs. 28 and 29.) An "implantation" carcinoma was present in the cervix, *imp.*, and also in the vagina (see text of article).

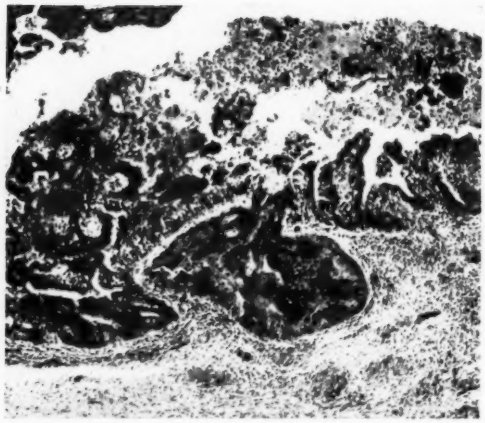

Fig. 28. Photomicrograph (×60) of a portion of the tube just back of the fimbriæ and distal to the ligature. Carcinoma apparently arising from the tubal mucosa is present and is of the same type as that found in the uterus. This growth was continuous with that shown projecting through the fimbriated opening in Figure 27. Could it have arisen from the implantation of bits of cancer escaping from the uterine cavity into the lumen of the tube? (See Fig. 29.) Cancer was not found in the deeper structures of this tube, but was present in the veins of the opposite tube. (See Fig. 58.)

made. While filling the uterine cavity with this injection mass, some of it would escape through the tubes, if the latter were patent, but the force (pressure) required to cause this varied greatly in different specimens, just as has been found in testing the patency of the tubes by the Rubin method. These studies furnished the material for a paper (7) which I presented at the meeting of the American Gynecological Society in 1918 on the escape of foreign material from the uterine cavity into the uterine veins and through the tubes. The roentgenographs made at that time showed that there was a great variation in the diameter of the lumen of tubes, especially of the interstitial portion, in different specimens. Some were very narrow and others comparatively wide, as is shown in the illustrations of the above-mentioned paper. I believe that if all women had tubes with a lumen of wide diameter in their interstitial portions, menstrual blood would escape much more frequently into the peritoneal cavity and endometrial implantation would be of even greater frequency.

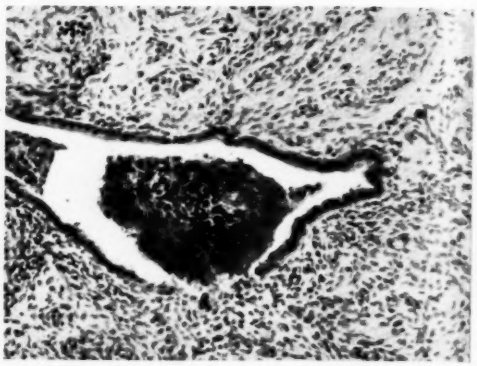

Fig. 29. Photomicrograph (×60) of a portion of the tube near the uterus. Fragments of cancer were found free in the lumen of the tube. It is impossible to state whether they were derived from the growth in the tube or from the uterine cavity. One of these fragments is shown adherent to the tubal mucosa, destroying the underlying tubal epithelium and invading it, demonstrating that these fragments may become implanted on tubal mucosa.

THE CLINICAL FEATURES OF BENIGN ENDOMETRIAL IMPLANTS AND THE CONDITIONS RESULTING FROM THEM

These implants are usually small and slow-growing and therefore do not give rise to any symptoms in the majority of cases. They are most often encountered in operations for leiomyoma and retroflexion of the uterus, especially in nulliparous patients, as well as in operations primarily undertaken for the relief of conditions resulting from endometrial implantation. They are rarely found at operations for conditions resulting from tubal infection and the injuries of childbirth. The influence of pregnancy on these implants is a very interesting one. Apparently it lessens their incidence, and the subsequent involutionary changes may possibly retard the future development, or even cause the retrogression of any implants present. Meigs (8) has suggested that lactation atrophy, which the uterus frequently undergoes during the nursing period, may cause small implants to disappear. In 45 of the 64 cases referred to in this series, the implants were small and without any symptoms referable to them at the time of the operation. I believe that in a few of these 45 cases, the further progress of the disease might have caused discomfort. In 19

of the patients, the conditions resulting from the implantation was either the sole or a contributory cause of the patient's discomfort. These symptoms arise chiefly from the reaction of the implants to menstruation, from the adhesions resulting from them, and from the invasion of the large intestine. Patients with ovarian hæmatomata or extensive implantation in the cul-de-sac, or both, usually present a very definite clinical picture, capable of diagnosis before operation in the majority of cases. The age of the patient (usually between 30 and the menopause); the acquired dysmenorrhœa or increase in menstrual pain (the disturbance of intestinal function during menstruation if some portion of the intestinal tract is involved); the detection of a small, adherent ovarian cyst or adherent ovary or ovaries; and the palpatory findings in the cul-de-sac (due to implants in this situation) present a syndrome rarely furnished by any other condition. When the perforation of an ovarian hæmatoma is associated with the escape of a large amount of its contents into the peritoneal cavity, the condition arising may simulate an attack of peritonitis.

The primary peritoneal implants as a whole usually remain small and do not cause trouble, but occasionally spread and become invasive. The implants on the ovaries are usually much more active, and frequently invade that organ and develop into menstruating ovarian cysts or hæmatomata, which as a rule are small, a few millimeters to 3 or 4 centimeters in diameter, but occasionally reach a large size (the largest I have encountered was about 15 centimeters in diameter). Whether small or large they usually perforate as a result of their reaction to menstruation, causing adhesions and further implantation. All the implants and the endometrial structures arising from them are influenced by ovarian function and react as does the mucosa of the uterine cavity to menstruation, pregnancy, and the menopause, whether the latter is natural or acquired. The operative treatment of this condition must, in a large measure, be determined by a knowledge of the natural course of the disease which has just been outlined. It must also be adapted to other conditions which

Fig. 30. (Case 2.) Malignant endometrial implants (sarcoma) diffusely distributed throughout the pelvis and abdominal cavity, associated with a large endometrial tumor of the uterus, apparently a stromal cell sarcoma, and also a small papillary adenocarcinoma of the uterus, the implants apparently primarily arising from tissue escaping through the tubes, the condition found at operation after exposing the pelvic contents and drawing the uterus upward and forward (×⅜). The uterus is enlarged. The implants are generally distributed, but are more numerous in some locations than in others, and were all of the same histological structure as the large tumor of the uterus. Both tubes were patent and fragments of the malignant tumor were found lying free in the lumen of one of them (Fig. 36). These facts, together with the distribution of the implants, indicate that they primarily arose from fragments of the malignant tumor of the uterus escaping through the tubes.

may be associated with it and to the desire on the part of the patient for conservative surgery. When ovarian conservation is not to be considered, the operation indicated is the removal of all ovarian tissue and the correction of whatever lesion is present, whether from implantation or associated conditions. I believe that intestinal resection is rarely required, as the endometrial tissue in the intestine should atrophy after all ovarian tissue has been removed. There may be an occasional exception to this rule.

The great problem is what shall be done when conservative surgery is desired. In encountering small implants at operation, in these cases, I always excise those in the ovary or ovaries, or remove only one ovary, and also

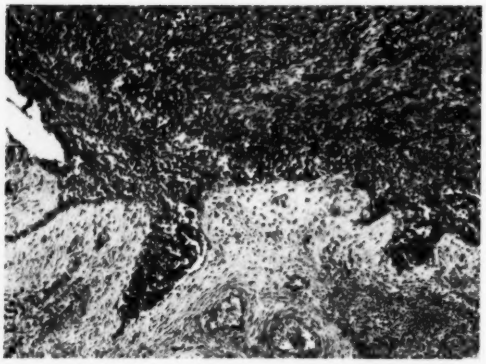

Fig. 33. (Case 2.) Photomicrograph (×60) showing a portion of one of the larger implants (Fig. 31) invading the ovary from its surface. The histological structure of the implant is similar to that of the large uterine tumor (Figs. 34 and 35) and also to the fragments of the tumor found free in the lumen of the tube (Fig. 36).

excise the peritoneal implants which may readily be removed. In addition an attempt is made to lessen the chance of further implantation by dilating the cervix and correcting any uterine displacement in patients desiring children, or by the removal of the tubes when future pregnancy is not to be considered. I believe that it is of the greatest importance to examine the ovaries carefully in all abdominal operations for pelvic conditions and remove any implants found, to prevent the possible future development of ovarian hæmatomata or even malignant ovarian tumors. The results of ovarian conservation in these cases will not be uniformly good, but it should be thoroughly tried out. Two of my patients whom I have thus treated have subsequently become pregnant, one aborted and the other is the proud mother of a living child. Both women were very anxious to have children. In two others that I have recently examined there is evidence of implantation in the cul-de-sac and the patients have not been entirely relieved. It is difficult to determine whether the lesion present in these two cases is the result of my not having completely removed all ectopic endometrial tissue present at the operation, or whether there may not have been other deposits from epithelium escaping through the tubes subsequent to the operation. It is also possible that in the

Fig. 34. (Case 2.) Sagittal section of the uterus showing a large endometrial tumor filling and distending the uterine cavity (×⅔). It has the gross appearance of a soft leiomyoma or sarcoma, with areas of necrosis and resultant cavity formation.

excision of dormant implants, particles left behind may have been stimulated to further activity.

Where ovarian hæmatomata are found with extensive peritoneal implantation and endometrial invasion of underlying structures, ovarian conservation (even though desired) is attended with a greater risk of not relieving the patient, but a second operation can always be done if necessary. I believe that conservative surgery in this group should be employed only in selected cases.

MALIGNANT IMPLANTS OF ENDOMETRIAL TYPE SECONDARY TO MALIGNANT TUMORS OF THE UTERINE MUCOSA AND ARISING FROM CELLS ESCAPING FROM THE UTERINE CAVITY THROUGH THE TUBES

As normal endometrial epithelium and stroma at times escape from the uterine cavity through the tubes during menstruation and

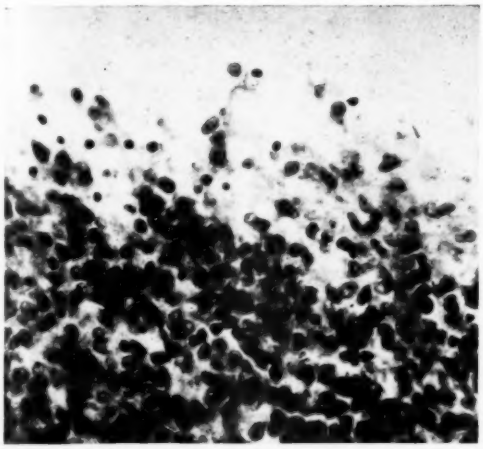

Fig. 35. (Case 2.) Photomicrograph (×310) of a section through the surface of a portion of the large uterine tumor. Blood in the uterine cavity containing bits of this tissue might at times escape through the lumen of the tubes and give rise to the implants. Sections of this tumor at its junction with the normal endometrium were similar to the one shown in Figure 41.

give rise to endometrial implants invading the pelvic structures; and as the implants invading the ovary may develop into endometrial cysts which are often bilateral and may at times reach a size of 10 to 15 centimeters in diameter, we should expect that similar peritoneal implantation and likewise malignant ovarian tumors would arise from cells escaping through the tubes from malignant tumors of the uterine mucosa. We should expect a similar primary distribution of the implants in the two groups of cases, and also that the malignant implants would grow more rapidly and give rise to more extensive secondary implantation. This is all true and we may go a step further in the study of the origin of malignant and benign epithelial ovarian tumors. As endometrial implants in the ovary are of common occurrence (observed in 45 of 296 abdominal operations for pelvic disease in 1 year), we would naturally infer that this tissue might undergo malignant changes and thus be a source of malignant ovarian tumors. This I have observed. It is also rational to believe that tubal and endometrial epithelium implanted in the ovary might be a source of varieties of ovarian tumors other than the typical menstruating endometrial cysts.

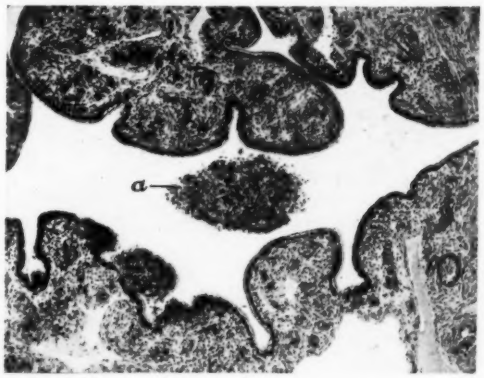

Fig. 36. (Case 2.) Photomicrograph (×60) of a section of a portion of the left tube showing a piece of the malignant tumor lying free in the lumen of the latter. It is of the same histological structure as the large uterine tumor and of the implants and I believe indicates the avenue by which the latter arose.

I have seen only 5 cases of malignant ovarian tumors associated with and of the same

Fig. 37. (Case 2.) Photomicrograph (×25) showing a typical papillary adenocarcinoma. A small area of thickened endometrium was found lateral to the large tumor. The section from which this photomicrograph was made was taken from this area. Possibly a further study of the specimen will show other areas of adenocarcinoma. Two varieties of malignant endometrial tumors were possibly present in this specimen; the larger one is apparently a stromal cell sarcoma (Figs. 34 and 35) and the smaller a papillary adenocarcinoma. The implants arose from the former.

Fig. 38. Case 3. Implantation carcinoma on the posterior surface of the uterus, both broad ligaments, cul-de-sac, sigmoid, omentum, and left ovary, associated with adenocarcinoma of the body of the uterus and possibly an endometrial sarcoma, the condition found at operation after exposing the pelvic contents and drawing the uterus upward and forward (×½). The uterus is slightly enlarged. The distribution of the implants is shown and is similar to that often found in benign endometrial implantation (Fig. 12). They were all of the glandular type. Both tubes were patent, particles of cancer were not found in the lumen of the tubes, but the distribution of the implants and the knowledge gained from the study of benign and other malignant implants would indicate that they primarily arose from malignant tissue escaping through the tubes.

Fig. 39. Case 3. Sagittal section of the uterus (natural size). The uterine cavity is distended by a typical adenocarcinoma of the glandular type, except for a portion indicated by *s* which has the gross appearance of a submucous leiomyoma, but is more homogeneous and softer. Histologically it is very cellular, without gland formation (Figs. 40 and 41).

histological structure as the malignant tumor of the accompanying uterus. Three of these 5 cases were observed during the last year when I was especially interested in the subject. Meigs (9) in a recent report of 44 cases of adenocarcinoma of the body of the uterus operated upon at the Free Hospital for Women, in Brookline, Massachusetts, describes five specimens in which metastases were found in one or both ovaries.

The question naturally arises, why does it not occur more often? Three explanations can be offered for the infrequency of implantations arising from cancer escaping through the lumen of the tubes in these cases. Carcinoma of the body of the uterus occurs most frequently in women after the menopause, when the tubes are smaller, with a consequent diminution in the caliber of their lumen, which would not as readily permit material to escape through them from the cavity of the uterus as in younger women. Twenty-nine of the 44 patients reported by Meigs were over 50 years of age, and the average age of 186 patients with carcinoma of the body of the uterus, recently reported by Mahle (10) from the Mayo Clinic, was over 55 years. The growth in the uterine cavity may also occlude the uterine openings of the tubes, thus preventing material suspended in blood in the uterine cavity from escaping into the lumen of the latter, or if cancer cells escaped into the peritoneal cavity conditions were not favorable for their growth.

The following 4 cases are of interest as demonstrating the dissemination of malignant tumors of the uterine mucosa from tissue apparently escaping through the lumen of the tubes.

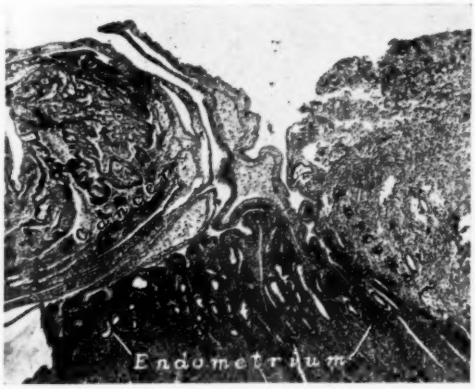

Fig. 40. Case 3. Photomicrograph (×25) of a section through both the glandular and "solid" tumors shown in Figure 39. To the left a typical adenocarcinoma arising from the endometrium is present and to the right a solid type of tumor (*s*, Fig. 39) also apparently arising from the endometrium (Fig. 41). In the center the normal endometrium is compressed laterally by the two tumors growing toward each other.

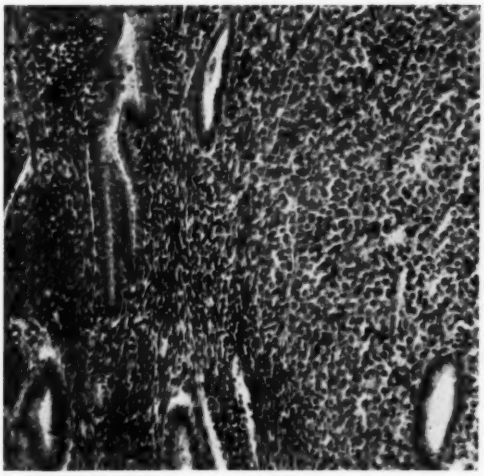

Fig. 41. Case 3. Photomicrograph (×130) of the "solid" tumor at its junction with the normal endometrium. The tumor to the right is apparently arising from the stroma cells of the uterine mucosa or gradually replacing them so that it is impossible to draw a sharp line between the tumor cells and those of the endometrial stroma. It is either an endometrial sarcoma or an atypical solid phase of the adenocarcinoma. I am undecided which it is.

CASE 1. Carcinoma of the left fallopian tube associated with carcinoma of the body of the uterus and apparently arising from the implantation of cancerous tissue on the tubal mucosa.

A. H. No. 89234. The patient, age 62, complained of uterine bleeding. She had been married, but had never been pregnant. Menstruation had always been profuse and she was unable to determine the date of the menopause as there had been more or less constant bleeding for the last 12 years. She had been curetted a year before I saw her, a diagnosis of malignancy was made, and the condition was considered "inoperable." Since that time she had had repeated X-ray treatments. Pelvic examination showed the uterus to be irregularly enlarged and there was a small nodule about 8 millimeters in diameter in the anterior vaginal wall, just beneath the urethra. The pre-operative diagnosis was cancer of the body of the uterus with a vaginal "implantation." Operation was at the Albany Hospital, March 16, 1923. No gross evidence of peritoneal implantation was found, but the lower fimbriæ of the left tube were adherent to the broad ligament and some of the fimbriæ just at the opening were swollen and more opaque than the others, suggesting carcinoma (Fig. 27). A ligature was placed about both tubes near the fimbriated ends, in order to prevent any cancerous tissue from being forced from the uterine cavity out through the tubes during the operation. The uterus, both tubes, and ovaries were removed (Fig. 54). The growth in the vagina was excised and the vagina was treated with radium. The patient made a satisfactory convalescence.

The uterus (Fig. 26) contained an extensive adenocarcinoma of both the glandular and solid type. Leiomyomata were also present. A carcinoma of the same type as that of the uterus was found in the distal end of the left fallopian tube, replacing the tubal mucosa (Fig. 28) and extending through the fimbriated opening (Fig. 27). The entire histological structure of this growth was that of one arising from the tubal mucosa or from a growth implanted upon and replacing it and not from a metastasis through lymph vessels or veins. Bits of cancerous tissue were found lying free in the lumen of the tube between the ligature and the uterus. In one place a piece of this tissue was adherent to the tubal mucosa, destroying the tubal epithelium and replacing it, thus demonstrating the implanting of cancer on the mucosa (Fig. 29). The ovaries were examined histologically and no evidence of cancer was found. Cancer was not found in the lumen of the right tube, but was present in the lumen of a vein in its wall. An "implant" of cancer was present in the cervical mucosa (Fig. 26). The nodule excised from the vaginal wall showed the same type of growth as that of the uterus.

It is not my purpose to discuss all the possible relations between the growth in the uterus and those in the tube, cervix, and vagina, but to present what seems to me to be a rational explanation of the origin of these "secondary" tumors. The uterus had been curetted a year before. As a result of the curettage and the manipulation of the uterus incident to it, bits of cancer were forced into the tube and became implanted on the tubal mucosa. The

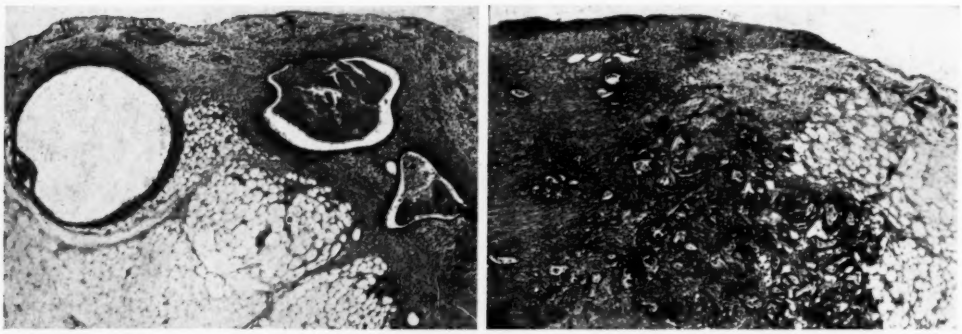

Fig. 44. Two photomicrographs (×25) of sections of the benign and the malignant endometrial invasion of the epiploic appendages shown in Figures 42 and 43. The benign type (to the left) consists of normal-sized and dilated glands, in places with a small amount of tissue about them resembling endometrial stroma, which in some areas is hæmorrhagic with blood also present in the lumen of some of the glands. The connective tissue of the appendage is increased. The malignant type (to the right) also consists of glands, the more superficial of which appear normal (Fig. 45)—but without any tissue about them resembling endometrial stroma. As they penetrate more deeply into the appendage they become transformed into typical adenocarcinoma (Fig. 45). This picture suggests that either the latter implantation was primarily benign and is undergoing malignant changes, or else that the implanted cancer cells reverted to normal, first developing into glands of a normal appearance and later manifesting their true character.

curette may have injured the cervical mucosa, thus permitting viable cancer cells, loosened by the curette, to develop in this situation. The "implant" in the vagina may have had a similar origin. The absence of any implants on the ovaries and peritoneum may be explained by assuming that cancer cells did not escape into the peritoneal cavity, or, if they did, conditions were not favorable for their growth.

CASE 2. Malignant endometrial implants (sarcoma) diffusely distributed throughout the pelvis and abdominal cavity, associated with a large endometrial tumor of the uterus apparently a stromal cell sarcoma, and also a small papillary adenocarcinoma of the uterus, the implants apparently primarily arising from tissue escaping through the tubes.

A. H. No. 87780. The patient, age 54, single, complained of pain in the lower abdomen and uterine bleeding. Menstruation had been regular and normal. The menopause occurred at the age of 50. This last bleeding was of over a year's duration. Pelvic examination showed what appeared to be a polyp protruding from the cervix. The body of the uterus, as such, was not recognized on bimanual palpation, but the pelvis was filled with a soft tumor (later shown to be the body of the uterus) extending upward into the abdominal cavity. Distinct nodules were felt in the cul-de-sac. The pre-operative diagnosis was a malignant ovarian cyst with implants in the cul-de-sac, and a cervical polyp. Operation was at the Albany Hospital, December 6, 1922. On opening the abdominal cavity a greatly thickened omentum was found, lightly adherent over the surface of the pelvic tumor, which proved to be an enlarged uterus. After freeing the omentum and exposing the pelvic contents (Fig. 30) many implants were found on the surface of the fundus of the uterus, ovaries (Fig. 31), loops of small intestines (Fig. 32), sigmoid, and in the cul-de-sac. The uterus and both tubes and ovaries were removed. The patient reacted badly after the operation, with a rapid pulse and elevation of temperature(symptoms of infection without those of peritonitis) and died on the fourth day. An autopsy was performed by Dr. Jacobson. The distribution of the implants found by him was as just described; metastases were not present in the lungs. No evidence of infection was found. A chronic fibrous myocarditis was the only pathological lesion present other than the malignant implants. On incising the enlarged uterus, the cavity was found to be filled by a tumor arising from the endometrium of the anterior wall which had the gross appearance of a soft submucous leiomyoma or sarcoma, with areas of necrosis and resultant cavity formations (Fig. 34). The histological structure of this tumor resembled a sarcoma more than a carcinoma (Fig. 35), and at its junction with the endometrium the tumor cells could be seen apparently arising from or replacing the stromal cells of the latter. (See also Figure 41, Case 3). At one side of this tumor a small papillary growth was found arising from the endometrium which histologically proved to be a papillary adenocarcinoma (Fig. 37). My present reaction is that there were two types of malignant tumors in this uterus, an endometrial stromal cell sarcoma and an adenocarcinoma. Dr. Jacobson agrees with this diagnosis, but intends to make a further study of the specimen.

All the implants studied were essentially alike and were similar in type to that of the large uterine tumor. No implants were found of the glandular type.

Both tubes were patent and bits of the growth were found free in the lumen of one of them (Fig

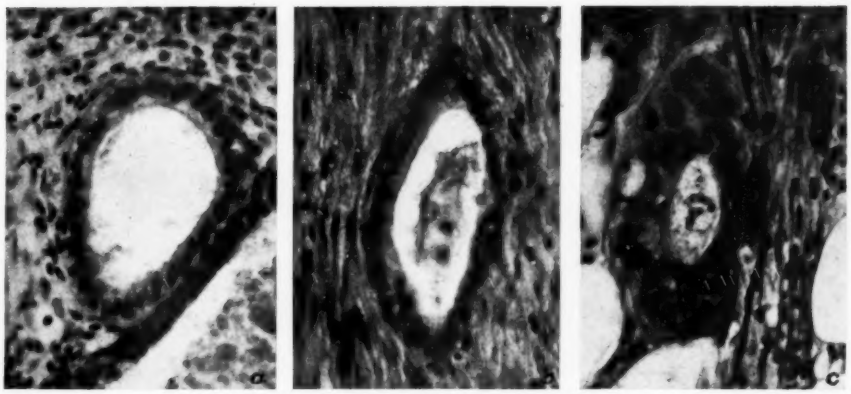

Fig. 45. Three photomicrographs (×310), the first showing a normal gland and a portion of a dilated gland of the benign endometrial implant of Figure 44, the second a normal appearing gland of the malignant endometrial implant, and the third the transformation of one of the latter into carcinoma. The histological structure of the glands shown in *a* and *b* is similar. In *c* the epithelial cells are growing rapidly, their nuclei are larger, mitotic figures are present, and the cells have lost their normal arrangement and have invaded the surrounding tissue.

36). The distribution of the implants also suggests that they primarily escaped through the tubes (Fig. 30). They were especially numerous on the surface of both of the ovaries more on the lateral surfaces, (Fig. 31), on the fundus of the uterus, terminal portion of the ileum (Fig. 32), on the sigmoid, and in the omentum, and the cul-de-sac; namely, the structures most easily reached by material escaping through the tubes.

CASE 3. Implantation carcinoma of the posterior surface of the uterus, both broad ligaments, cul-de-sac, sigmoid, omentum, and left ovary, associated with adenocarcinoma of the body of the uterus and possibly an endometrial sarcoma.

A. H. No. 87799. The patient, age 63, complained of abdominal pain and uterine bleeding. She was a widow who had had one child, 32 years ago. The menopause occurred at the age of 55. She had had uterine bleeding for 5 years, but it had never been profuse. Abdominal palpation was negative, except for a sense of resistance just above the right Poupart's ligament. Pelvic examination showed that the uterus was enlarged and in normal position. There was marked induration in the cul-de-sac and an indefinite mass to the right of the uterus at the pelvic brim. The tentative pre-operative diagnosis was an ovarian carcinoma of the right side, with implantation in the cul-de-sac, and also possibly an associated carcinoma of the body of the uterus. At the operation at the Albany Hospital, December 8, 1922, the omentum was found to be greatly thickened and adherent at the brim of the right side of the pelvis, presenting the gross appearance of malignancy. (This had led to the pre-operative diagnosis of ovarian carcinoma.) Both ovaries were atrophied, both tubes appeared normal, and the uterus was slightly enlarged. Implants were found on the posterior surface of the uterus, both broad ligaments, cul-de-sac, and sigmoid (Fig. 38). The entire uterus and both tubes and ovaries were removed. The patient made a satisfactory convalescence.

The entire specimen was hardened in 10 per cent formalin. A sagittal section of the uterus (Fig. 39) showed that its entire cavity was distended by a typical adenocarcinoma except for a tumor about 2.5 centimeters in diameter which had the gross appearance of a submucous leiomyoma, but was more homogeneous and softer. Histologically the latter was very cellular, without gland formation, differing somewhat from the usual solid type of adenocarcinoma and resembling more closely the endometrial sarcoma described in Case 2, but was not as typical of sarcoma as the latter. Just as in Case 2, at the junction of the solid tumor with the endometrium, the tumor cells could be seen apparently arising from or replacing the stromal cells of the latter, so that it was difficult to determine the exact line of demarcation between them (Fig. 41). The implants were all alike and of the glandular type. Epithelial cells, when present on the surface of the implants, resembled normal uterine epithelium, and the glands in the superficial portions of the majority of the implants did not in any way suggest malignancy, but were identical in their histological structure with the glands found in benign endometrial implants (Fig. 44). The glands in the deeper portions of the implants gradually assumed the typical histological structure of malignancy (Fig. 45). The histological study of the implants presents a very interesting problem. Were there benign endometrial implants before the cancer of the uterus developed, and was there a simultaneous development of malignancy both in the mucosa of the uterus and in these implants? If

Fig. 46. Case 4. Bilateral ovarian carcinoma, associated with an adenocarcinoma of the body of the uterus, all three tumors having the same histological structure. Posterior view of the uterus, tubes and ovaries (×½). Were the ovarian tumors derived from the uterine tumor from bits of malignant tissue escaping through the tubes and becoming implanted on the surface of the ovaries, just as benignant endometrial implantations on the ovary may arise and develop into benign endometrial cysts? The latter are often bilateral and the ovaries may be the only structures in the pelvis involved. The tubes of this specimen were patent.

these implants arose from the escape of epithelium from the adenocarcinoma of the uterus, we must infer that at first they assumed the histological structure of normal uterine glands and that in some way they displayed their true character only after they had invaded the deeper tissues. Dr. Jacobson suggested that both normal and malignant uterine epithelium may have escaped simultaneously through the tubes, but the age of the patient was against the probability of normal endometrium becoming implanted. Sections were made of both tubes, and while a small amount of blood was found in each, bits of definite cancerous epithelium were not seen. A small malignant implant was found on the surface of the left ovary. The study of other cases of benign and malignant implants and the distribution of the implants in this case leads me to believe that the latter primarily arose from epithelium escaping from the uterine cavity through the tubes.

Case 4. Bilateral ovarian carcinoma with ascites and early (microscopic) peritoneal implants associated with adenocarcinoma of body of uterus, all three tumors having the same histologic structure.

A. H. No. 88548. The patient, age 63, complained of abdominal distention. She had had three children, the youngest being 32 years of age. The menopause occurred at the age of 54, and there had not been any bleeding from the uterus since that time, until recently, when a serous blood-tinged discharge had been present. The abdominal distention was first noticed 4 weeks before I saw her and had increased rapidly. The abdomen was greatly distended and presented the physical signs of ascites. Pelvic examination showed that the uterus was retroflexed and that there was a tumor on each side about the size of one's fist. Implantation was not detected in the cul-de-sac. The pre-operative diagnosis was bilateral malignant ovarian cysts with ascites. At the operation at the Albany Hospital, January 29, 1923, the abdominal cavity was found filled with fluid. The peritoneum and omentum were markedly injected, but without the characteristic gross appearance of implantation carcinoma. Both tubes and ovaries and the entire uterus were removed (Fig. 46). A supravaginal hysterectomy was first done in order to disturb the ovarian tumors as little as possible; and the cervix was removed afterward. The patient made a satisfactory convalescence.

A sagittal section of the uterus (Fig. 48) shows a papillary growth arising from the endometrium of the anterior wall and distending the uterine cavity. Histologically it is one of papillary adenocarcinoma, arising from the uterine mucosa (Fig. 50). The gross appearance of the ovarian tumors is shown in Figures 46 and 47. The histological structure of the ovarian and uterine tumors is identical (Fig. 49). Histologically the peritoneum was injected and in places granulation tissue had developed with an occasional small malignant implant imbedded in it. The latter were probably derived from the ovarian tumors, as the ascitic fluid contained clumps of epithelial cells. Certain questions naturally arise.

1. Was there a simultaneous development of cancer in both ovaries and the uterus, and if so, did the malignancy in the ovaries arise in endometrial tissue resulting from benign endometrial implants which had remained benign for many years?

2. Was the uterine carcinoma secondary to the ovarian, from malignant epithelial cells carried

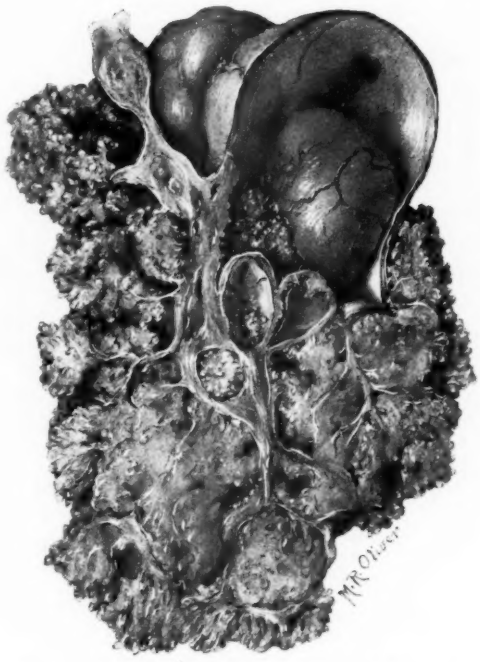

Fig. 47. Case 4. Cross section of one of the ovarian tumors (natural size), showing the gross appearance of the growth (Figs. 48 and 49).

Fig. 48. Case 4. Sagittal section of the uterus (natural size) showing the gross appearance of the uterine tumor. It is a papillary adenocarcinoma (Figs. 49 and 50).

through the tubes into the uterine cavity and becoming implanted on the uterine mucosa?

3. Were the ovarian tumors secondary to the uterine, being derived from epithelium escaping through the tubes and becoming implanted on the surface of the ovaries just as benign endometrial implants on the ovary arise and develop into endometrial cysts? The latter are often bilateral and the ovaries may be the principal or the only structures in the pelvis involved. Both tubes were patent and a small amount of blood with clumps of epithelium was found in the lumen of one of them. I was unable to convince myself that this epithelium was malignant. The uterine tumor is of a type found in adenocarcinoma of the body of the uterus and arose directly from the uterine mucosa, and the surface epithelium of the non-malignant endometrium was continuous with that of the papillary adenocarcinoma (Fig. 50).

I believe that these four cases demonstrate (a) that malignant endometrial tissue may at times escape from the uterine cavity out through the tubes into the peritoneal cavity and give rise to peritoneal and ovarian implants and (b) that the latter may develop into malignant ovarian tumors just as normal endometrial tissue escapes through the tubes, causing endometrial growths on the surface of the peritoneum and ovaries. The latter may also develop into benign endometrial cysts.

MANIPULATION OF THE UTERUS BEFORE AND DURING OPERATION AS A CAUSE OF THE DISSEMINATION OF CANCER OF THE BODY OF THE UTERUS THROUGH THE TUBES INTO THE PERITONEAL CAVITY

As normal uterine epithelium cast off by menstruation into the uterine cavity may at times escape through the tubes into the peritoneal cavity and give rise to endometrial growths, and as cells from malignant tumors of the endometrium may also escape through the tubes and cause malignant implantation, we would expect that the manipulation of the uterus during pelvic examinations, treatments, and operations, would at times be responsible for the origin of these. I believe that this is true.

It is a common procedure in gynecological operations for the relief of retroflexion and

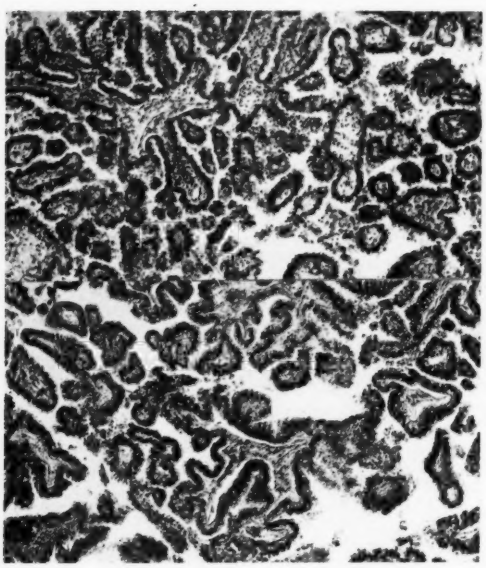

Fig. 49. Case 4. Two photomicrographs (×60) from sections of the ovarian and uterine tumors shown in Figures 47 and 48. The upper half is from the ovary and the lower half from the uterus. The histological details of the two are identical. Did the ovarian tumors arise in benign endometrial implants which are of common occurrence in the ovaries, or from the implantation of bits of malignant tissue escaping from the uterine tumor through the tubes, as often occurs in benign endometrial implantation? I believe the latter. (See Fig. 50.)

Fig. 50. Case 4. Photomicrograph (×25) of a section of the uterine tumor at its junction with the normal endometrium. The latter (to the right) is atrophic and its surface epithelium is continuous with that of the carcinoma and the latter is definitely arising from the uterine mucosa. Bits of malignant tissue broken off from this tumor might easily escape through the tubes and become implanted on the surface of the ovary, just as menstrual blood carrying epithelium may escape through the tubes and cause benign endometrial implantations on the ovaries. These may develop into benign endometrial cysts which are often bilateral.

descensus of the uterus first to curette the uterus, repair the pelvic floor, if that is needed, and then open the abdominal cavity and do one of the many operations for the correction of uterine displacement. After curetting the uterus the operator often replaces it, and palpates the body of the uterus between the finger, or fingers, in the vagina and the hand on the abdomen. If the tubes are patent some of the blood in the uterine cavity, holding in suspension fragments of endometrium scraped away by the curettage, will at times be forced into the tubes (Fig. 51). The uterus may be compared to a rubber syringe with two nozzles (the two tubes). The more thorough the curettage and the greater the manipulation, the greater the chance for material in the uterine cavity to gain access to the peritoneal cavity. If the fimbriated ends of the tubes are carefully examined, on opening the abdominal cavity, after curettage, blood may sometimes be seen escaping from the fimbriated opening of one or both tubes. If the body of the uterus is grasped between the thumb and fingers of one hand, and the tubes gently stripped from the uterus toward the fimbriated end, more blood may sometimes be expressed from the latter. I made these observations in 14 cases in which I had curetted the uterus prior to an abdominal operation for the correction of uterine displacement, and found that in 8 cases blood had been forced into one or both tubes. In two instances, bubbles of air also appeared on gently stripping the tubes. The blood was collected by means of a medicine dropper in several instances, smears were made and stained, and in them epithelial cells were found by Dr. Lyle A. Sutton. In 4 cases in which I wished to prevent further conception, the tubes were first cut close to the uterus and then the rubber-syringe-like action of the uterus was well demonstrated in 3 of these; for on squeezing the fundus of the uterus, blood was forced through the lumen of severed tube (Fig. 52).

I do not know to what extent bimanual examination, curettage, the Rubin test for patency of the tubes, and operative manipu-

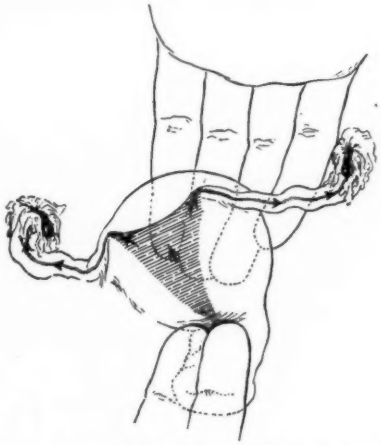

Fig. 51. (×½). In the bimanual palpation of the uterus the pressure exerted by the hand on the abdomen and the fingers in the vagina often closes the cervical canal and may force any fluid contents of the uterine cavity out through the tubes, if the latter are patent. The uterus may be compared to a rubber syringe with two nozzles—the two tubes. If the contents of the uterine cavity harbor bacteria, peritonitis may result; if they harbor cancer cells set free in the uterine cavity by manipulation or curettage, implantation of cancer may occur in the pelvis. In 14 patients in whom a curettage of the uterus and bimanual palpation of the same preceded an abdominal operation for uterine displacement, blood was found escaping from the fimbriated ends of one or both tubes in eight. (See text.)

Fig. 52. (×½). In 4 patients in whom a curettage of the uterus preceded the abdominal operation and the uterine ends of the tubes were cut in order to prevent further conception, blood could be forced from the lumen of the severed ends of the tubes in three of these, by squeezing the body of the uterus. These observations demonstrate the possible danger of bimanual palpation, curettage, and the manipulation of the uterus during hysterectomy, in forcing the contents of the uterine cavity out through the tubes, and therefore the importance of ligating the fimbriated ends of the tubes in hysterectomy for cancer of the body of the uterus. (See Figs. 54, 55 and 56.)

lation of the uterus, are responsible for the origin of benign endometrial implantation. A more important problem presents itself, and that is the dissemination of cancer of the body of the uterus through the tubes during pelvic examination, curettage, the application of radium, and hysterectomy. We are too well satisfied with the results of the operative treatment of cancer of the body of the uterus, because the percentage of cures is low compared with the operative treatment of cancer of the uterine cervix. If bimanual examination of the bleeding uterus, curettage and operative manipulation will, at times, force blood containing in suspension bits of normal endometrial tissue through the tubes, these same procedures will also at times force blood containing cancer cells through the tubes into the peritoneal cavity, if the patient has cancer of the uterine body and the tubes are patent. Should this epithelium fall on suitable soil and grow, the patient will die from cancer, even though the primary growth in the uterus is subsequently entirely destroyed by radium, or the uterus is removed. A preliminary diagnostic curettage is usually done before the introduction of the radium, and the capsule containing the radium would act as a piston in a piston syringe, forcing the contents of the uterine cavity into the tubes (Fig. 53). The question naturally arises, why does this not occur in every instance in which the tubes are patent? In the majority of the cases of cancer of the body of the uterus, the patient is fortunately past the menopause, when the tubes are atrophic, with a consequent diminution in the caliber of their lumen. In other cases the growth may be so extensive as to block the opening of the tubes into the uterus. Again, the epithelium escaping through the tubes may not give rise to implantation in every instance, i. e., conditions may not be favorable for its growth.

In the year 1904, while on Dr. Howard A. Kelly's staff at the Johns Hopkins Hospital,

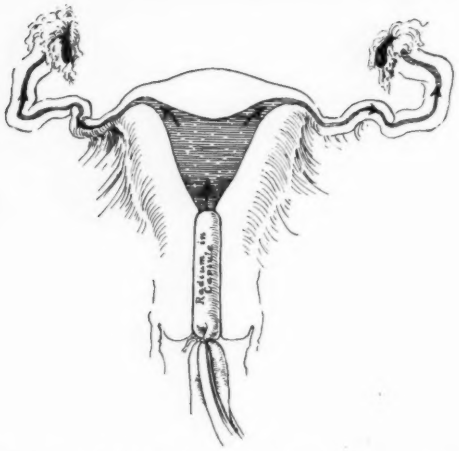

Fig. 53. (×½). In introducing the capsule containing radium into the uterine cavity through the cervix the uterus is converted into a piston syringe—the capsule, acting like a piston, might force the fluid contents of the uterine cavity out through the tubes (the two nozzles of the syringe), if the latter were patent, and should implantation of cancer occur in the pelvis the patient would die from cancer, even though the primary growth in the uterus was destroyed by the radium, or the uterus was later removed by operation.

I designed a right angle clamp for clamping across the vagina below the cervix, in abdominal hysterectomy for cancer of the uterine cervix. This clamp was but a modification of the clamp described by Wertheim for this purpose. Since that time I have used this clamp as a routine procedure in hysterectomy for both cancer of the cervix and body of the uterus. After clamping across the vagina below the cervix a vaginal douche is given and the vagina is wiped dry with bits of gauze, before cutting across the vagina below the clamp and removing the uterus. This procedure is followed for two purposes: to prevent the infection of the field of operation with bacteria, and to prevent the possible implantation of bits of cancer in the pelvis.

My reaction toward the diagnostic curettage in suspected cancer of the body of the uterus has undergone a change in the last 10 years. This was brought about chiefly by my experience with 2 patients. The first occurred in 1912. A "recurrence" of cancer followed soon after a hysterectomy for early cancer of the body of the uterus in which there had been a preliminary diagnostic curettage. The following year I found blood in the cul-de-sac of a patient who had also had a preliminary curettage. I thought that possibly I had perforated the uterine wall with the curette, but was unable to find any evidence of this. It did not occur to me to examine the fallopian tubes. The patient subsequently died from a recurrence of the cancer. Since that time I have used the diagnostic curettage in patients with uterine bleeding only in those in whom I did not suspect cancer or when I considered the patient a poor operative risk. In all other cases of suspected cancer of the body of the uterus I remove the uterus without a preliminary curettage. I have found that the diagnosis of cancer of the body of the uterus can be made with reasonable certainty in a large percentage of patients with this condition, without resorting to curettage.

In March, 1922, I found blood and clumps of epithelial cells in the lumen of a tube from a specimen of cancer of the body of the uterus. I had done a preliminary diagnostic curettage, as I considered the patient a poor operative risk. In November of the same year, Dr. Jacobson, knowing my interest in the escape of the contents of the uterine cavity into the tubes, called my attention to a section from one of my cases of cancer of the body of the uterus, in which a clump of epithelial cells was present in the lumen of one of the tubes, the epithelial cells being of the same histological structure as those of the adenocarcinoma of the uterus. The patient had had a diagnostic curettage in another hospital a week before I had operated on her.

Schiller (11) has reported a case of free cancer particles in the tube of a specimen of primary carcinoma of the body of the uterus. He states that his case was similar to one reported by von Franque. He believes that the displacement of the tumor particles into the tube can be explained by assuming that these particles were pressed into the tube by contractions of the uterus, and that the normal contractions of the tube and the action of its ciliated epithelium were not strong enough to overcome this invasion. In this paper he also discusses the origin of peritoneal and ovarian implantations from this source. I believe that

there are often more important factors in causing this displacement, as, a damming back of blood in the uterine cavity; and the forcing of blood from the uterine cavity into the tubes in bimanual palpation, by the curette, in the manipulation of the uterus during the curettage, if that has been done, and especially during the manipulation of the uterus incident to hysterectomy.

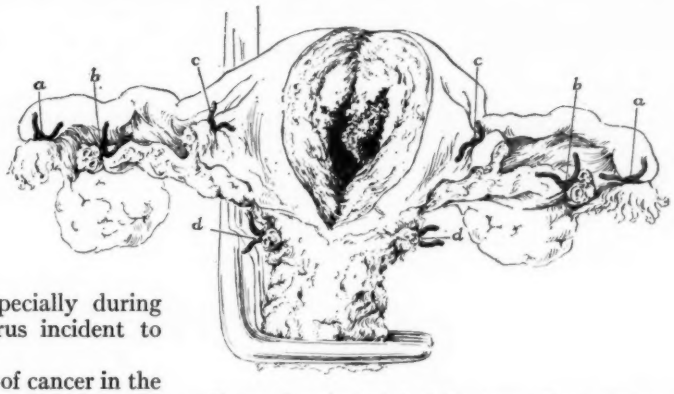

Fig. 54. Drawing (×¼) of the uterus, tubes, and ovaries, showing the methods used to prevent particles of cancer from escaping from the uterus into the pelvis, during hysterectomy. The patient (A. H. No. 88958) age 55, complained of uterine bleeding of 2 months' duration, but had not had a diagnostic curettage. The fimbriated ends of both tubes were ligated to prevent any particles of cancer present in the lumen of the tubes before the operation, or forced into it during the latter, from escaping into the peritoneal cavity during the manipulations incident to hysterectomy (Fig. 55). The ovarian and uterine vessels and round ligaments were ligated doubly and cut between the ligatures, to prevent any particles of cancer protruding into the venous sinuses of the uterine wall, or present in the lumen of the veins, from escaping into the pelvis during the operation (Figs. 57 and 58). The vagina was clamped below the cervix and thoroughly cleansed before severing it and removing the uterus, thus preventing any of the material in the uterine cavity (Fig. 56) from escaping into the field of operation.

The finding of free particles of cancer in the lumen of the tube, in two specimens of cancer of the body of the uterus operated upon by me, together with the knowledge that benign and malignant endometrial implants arise from epithelium escaping through the tubes into the peritoneal cavity, caused me to adopt what I consider a very important procedure in preventing the dissemination of cancer of the body of the uterus during hysterectomy. This is *the ligation of the fimbriated ends of both fallopian tubes before attempting to remove the uterus.* This is of scientific value because it prevents material, present in the lumen of the tubes before operation, or forced into them during it, from being squeezed out through the fimbriated extremity by operative manipulation, and thus lost for microscopic study. It is of humanitarian importance in preventing the possible implantation of cancer in the pelvis, and the subsequent death of the patient from the so-called recurrence of cancer, which the surgeon had unintentionally caused. I have carefully examined the tubes in four specimens of cancer of the body of the uterus in which this procedure was employed, and found blood and particles of cancer in two. For the findings in one of these see Figures 55 and 56.

The histological study of the myometrium, in specimens of cancer of the body of the uterus, demonstrates that at times cancer may be found penetrating and projecting into the venous sinuses of the uterine wall (Fig. 57). The manipulation of the uterus in bimanual examination and in operative procedures is attended with the danger of breaking off particles of these projections and permitting them to be carried into the uterine and ovarian veins, from which they may be carried to the lungs or escape into the peritoneal cavity during the operation, unless the uterine ends of the veins are occluded by ligature or clamp. Clamps attached to the uterine end of the ovarian and uterine veins are likely to slip, so I believe that it is safer, in hysterectomy for cancer of the body of the uterus, to ligate doubly the ovarian and uterine vessels, with the least possible manipulation of the uterus, and cut between the ligatures, so that blood from the uterus cannot escape from these severed vessels into the peritoneal cavity.

The various steps to prevent the implantation of particles of cancer, in hysterectomy for cancer of the body of the uterus, are indicated in Figure 54.

CONCLUSIONS

The implantation of benign endometrial tissue upon the surface of the various structures in the pelvis is of common occurrence. It was observed by me in 64 of 296 abdominal operations for pelvic conditions in 1 year.

The implants, wherever situated, may invade the underlying tissue on which they develop, spread over the surface of the same, or invade other structures in contact with them. In their reaction to menstruation, epithelium may be cast off and give rise to other or secondary implants.

The peritoneal implants are usually small, slow growing, and insignificant, but occasionally spread and become invasive.

The ovarian implants are frequently much more active than the peritoneal, suggesting that the ovary is generally their most "fertile soil." They often develop into superficial or deep menstruating ovarian cysts. The superficial cysts are small, a few millimeters in diameter, while the deeper ones may reach a much larger size, several centimeters in diameter. Whether small or large, these endometrial cysts or hæmatomata often perforate, and some of their contents, carrying epithethelium cast off by menstruation, escapes into the peritoneal cavity. Other or secondary implants apparently arise as a result of these perforations. The ovary may be considered an incubator, hot bed, or redistributing focus, in the origin of these secondary growths.

The evidence that these implants may primarily arise from epithelium, with, at times, bits of stroma derived from the uterine mucosa (possibly occasionally from the tubal mucosa), as a result of a back-flow of menstrual blood

PLATE IV

Fig. 27. (Case 1.) Left tube and ovary (natural size). The lower fimbriæ of the tube are adherent to the surface of the broad ligament below the ovary. The fimbriæ, *c*, just below the opening of the tube are thickened and invaded by cancer extending out through its opening. A ligature had been placed about the tube to prevent any material in its lumen from escaping into the pelvis during the operation. Ovarian or peritoneal implants of cancer were not found.

Fig. 31. (Case 2.) Left tube and ovary (natural size). The ovary is turned upward, exposing its lateral surface, which is studded with malignant endometrial implants in all stages of development (more numerous on the lateral surface of the ovaries, as occurs in benign endometrial implantation). Implants are also present on the surface of the broad ligament.

Fig. 32 (Case 2.) A portion of the terminal loop of the ileum (natural size), on which the malignant endometrial implants are especially numerous. Compare with Figure 14, showing benign endometrial implants also on the surface of the terminal loop of the ileum. The reaction of the benign implants to menstruation enables them to be readily recognized and distinguished from the malignant ones.

Fig. 42. Epiploic appendage of the sigmoid with benign implantation endometrial invasion (natural size) from the same case as the illustrations shown in Figures 5 and 6. The gross appearance of the appendage with the pigmentation due to menstruation in the endometrial tissue is characteristic of this lesion. Compare with Figure 43 (see also Figs. 44 and 45).

Fig. 43. Epiploic appendage of the sigmoid with malignant implantation endometrial invasion (natural size). Case 3. The gross appearance of the appendage is characteristic of this lesion and differs from that shown in Figure 42 (see also Figs. 44 and 45).

Fig. 55. Colored photomicrograph (×310) of a portion of a cross section of one of the tubes shown in Figure 54. The lumen was filled with blood, leucocytes, and an occasional clump of epithelial cells which were similar to the clumps of cancer cells found in the débris in the uterine cavity (Fig. 56). One of these clumps is shown surrounded by blood with a greater proportion of leucocytes than is present in normal blood. At the left is the tip of a villus of the tubal mucosa. I believe that the bloody contents of the tube containing clumps of malignant cells escaped from the uterine cavity into the tubes before the operation, or were forced into the latter during operative manipulations. The ligature about the fimbriated ends of the tubes was of scientific value in preventing the loss, for microscopic study, of this material and was also of humanitarian importance as an aid in preventing the implantation of cancer in the pelvis and the subsequent death of the patient from a so-called recurrence of cancer.

Fig. 56. Colored photomicrograph (×310) of a section through the surface of the cancer of the body of the uterus (Fig. 54). The débris is histologically similar to that found in the tubes and indicates the origin of the latter. Clinical and pathological studies demonstrate that particles of cancer escaping into the pelvis may cause implantation of cancer. Hence the importance of ligating the tubes and clamping across the vagina below the cervix before removing the uterus, as shown in Figure 54.

Fig. 57. Colored photomicrograph (×60) of a section of a portion of the uterine wall (Fig. 54). Cancer has invaded the lumen of a venous sinus. Manipulation of the uterus before or during the operation might easily dislodge such tissue and permit fragments of it to escape into the uterine or ovarian veins. It is important to examine gently patients in whom we suspect cancer of the body of the uterus. It is likewise important in hysterectomy to ligate doubly the ovarian and uterine veins and to cut between the ligatures with the least possible manipulation of the uterus, as indicated in Figure 54.

Fig. 58. Colored photomicrograph (×60) of a portion of a section of the right tube of the specimen shown in Figure 26. Cancer is present in the veins in the outer portion of the wall of the tube, the opposite tube from the one containing cancer in its lumen (Figs. 27, 28 and 29). This section emphasizes the importance of avoiding vigorous bimanual examination and curettage, and likewise the necessity of controlling the venous outlets of the uterus in hysterectomy

Fig. 27

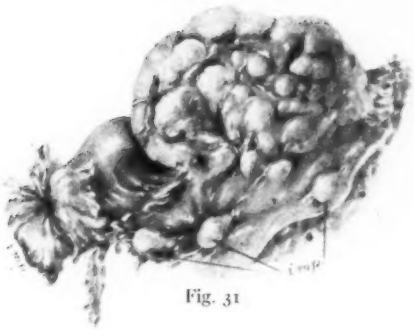

Fig. 31

Fig. 32

Fig. 42

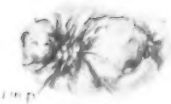

Fig. 43

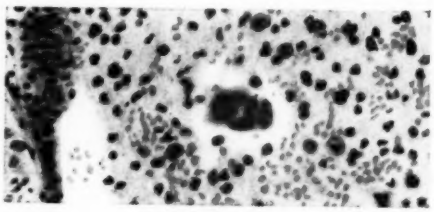

Fig. 55

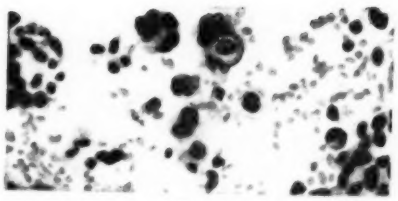

Fig. 56

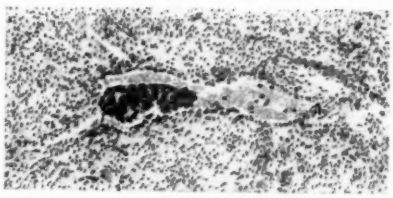

Fig. 57

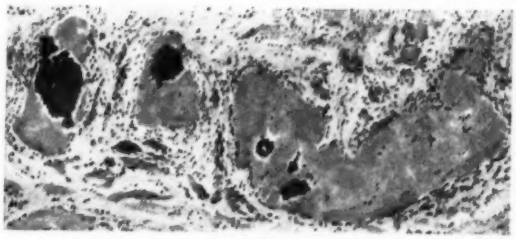

Fig. 58

PLATE IV.—(See legends on opposite page.)

Benign and Malignant Endometrial Implants in the Peritoneal Cavity.—John A. Sampson

through the tubes, is as conclusive as that of the origin of any pathological condition (see text of article).

These implants and the endometrial structures arising from them react to menstruation, pregnancy, and the menopause (natural or surgical), in the same way as does the mucosa lining the uterine cavity. They are thus governed by the same natural laws as the latter and we would infer that they are liable to similar pathological changes. I am convinced that malignant ovarian tumors may arise in these benign endometrial structures in the ovary (this I have observed), and also in the benign peritoneal implants. Future studies will determine to what extent the implantation of uterine and tubal tissue on the ovary is responsible for the development of ovarian tumors other than typical menstruating endometrial cysts.

Bits of malignant tissue, from malignant endometrial tumors, also at times escape from the uterine cavity through the tubes and give rise to peritoneal and ovarian implants. The latter may develop into malignant ovarian tumors (see text of article).

Clinical observations (see text of article) demonstrate that curettage and manipulation of the uterus may force blood containing bits of endometrial tissue out through the tubes into the peritoneal cavity. The uterus may be compared to a syringe with two nozzles, the tubes, sometimes acting as a rubber syringe and at other times as a piston syringe (Figs. 51 and 53). Should the tissues escaping into the peritoneal cavity be malignant, the patient may die from a so-called recurrence of cancer, even though the primary growth be subsequently destroyed by radium or the uterus be removed. Particles of cancer were found lying free in the lumen of the tube in four of seven specimens of cancer of the body of the uterus removed by me this last year. Three of these 4 patients had had a diagnostic curettage (only one done by me).

Bearing in mind the readiness with which endometrial tissue may become implanted and grow in the tissues of the pelvis, and the avenues and the means by which it may escape from the uterus, it is of the greatest importance to attempt to prevent this implantation in the diagnosis and the treatment of cancer of the body of the uterus.

It seems advisable to lay down the following rules in the treatment of this disease:

1. A patient in whom cancer of the body of the uterus is suspected should be examined with great care and gentleness.

2. The diagnostic curettage should be employed only in doubtful cases or poor operative risks, and if used should be done very gently.

3. Radium should not be used, as the insertion of the capsule containing the radium acts as the plunger of a piston syringe, forcing contents of the uterine cavity into the tubes.

4. Abdominal hysterectomy with the least possible manipulation of the uterus, and the closure of the channels through which material may escape from the uterus into the field of operation, offer the best chance for a permanent cure. The fimbriated ends of the fallopian tubes should be first ligated; the ovarian vessels, round ligaments, and uterine vessels should be doubly ligated, cutting between the ligatures; the vagina should be clamped below the cervix and carefully cleansed before severing the vagina below the clamp and removing the uterus.

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CO-ORDINATION OF HUMAN VEGETATIVE FUNCTIONS[1]

By WILLIAM J. MAYO, M.D., F.A.C.S., Rochester, Minnesota

THE era of surgery based on gross pathology is passing. Investigations of a physiological nature are enabling the detection of pathological changes in tissues in the early transitional periods; this fact leads to the hope that many diseases can be recognized at such an early stage of deviation from the normal that they may be prevented from assuming serious aspects. Because of this hope, the work of the physiologist is being followed with the greatest interest by the surgeon, and deductions are being made which effect the whole surgical concept. Cathcart and Benedict estimate that only 25 per cent of the energy produced in the body can be expended by the tissues under the control of the will, 75 per cent being used by the vegetative functions of the body, of which we are unconscious. In order to obtain a general view of the subject I have reviewed briefly, as related to those functions of which we are conscious (25 per cent), some facts and near facts which underlie the mechanism of co-ordination and control of the vegetative functions (75 per cent). "He that does not go beyond the facts," said Huxley, "will seldom get as far as the facts."

NON-STRIATED MUSCLE

Non-striated muscle is one of the most interesting and important tissues of the body, not only because it is the tissue earliest concerned in motion, but because it has been endowed with a curious type of self-control possessed by few, perhaps by no other, tissues in the body. Non-striated muscle originates its own action, and within the limits of the influences which necessitate the action, it is self-sufficient. The production of power to carry on the vegetative functions lies in the non-striated muscular system, and the ultimate source of this power is molecular and colloidal energy released through enzyme action which is as marvelous as the energy in radium. It has been demonstrated experimentally that if the thoracic and abdominal viscera are disconnected completely from all nerve connections, and the circulation and respiration are continued artificially, the liver will secrete bile, the kidneys urine, and the digestive functions will be continued, suggesting that physical laws play the predominant part in the functions of organs. The modern biochemical theory, for example, in relation to the action of enzymes, assumes that the enzymes are controlled by physical and chemical laws, which possibly represent a rapid colloidal bombardment of the attacked material by its peculiar type of energy.

Krogh, whose experimental studies on the blood capillaries gave him the Nobel prize in physiology in 1920, has added greatly to our knowledge of the mechanism of body nutrition. It had been believed that the capillaries were endothelial channels, but Krogh confirmed the observation that even the finest capillaries contain smooth muscle fibres through the walls of which oxygen and crystalloids, such as glucose sugar and the amino-acids, supply the body cells by diffusion. Crystalloids are in a molecular state and penetrate the capillary walls everywhere, because the pressure inside the arterial capillaries is greater than that in the tissue spaces, and greater in the tissue spaces than in the venous capillaries which receive the waste products of oxidation, but unless there is great dilatation of the capillaries which increases their permeability to larger bodies the colloids do not penetrate the capillary walls, except in the liver and gastro-intestinal tract. The colloids of the blood are made up of different sized molecules; hence, there is variation in the permeability of the capillary wall to different colloids. The osmotic pressure, the state of dilatation of capillaries, and the size of the colloid molecule are the controlling factors. Increased work of any organ of the body causes dilatation of the capillaries. This power of dilatation and contraction lies in the non-striated muscle coat. Variations in caliber of the capillaries may be brought

[1]Read before the Clinical Congress of the American College of Surgeons, Chicago, October 22–26, 1923.

about by the many influences which affect life processes, and are to a great extent independent of nerve control. For instance, the effect of cold on the skin is to produce contraction of the arterial capillaries, resulting in blanching, which is followed by blueness due to dilatation and stasis of the venous capillaries distended with non-oxygenated blood. Krogh's experiments show that histamine causes enormous dilatation of the venous capillaries, resulting in more or less complete stasis of the red corpuscles and escape of the colloids of the blood plasma into the tissues. The animal under experimentation bleeds to death in its own tissues, so to speak, reproducing the picture of shock, which suggested to Krogh that pituitrin, an agent that causes dilatation of the arterial capillaries, might be of use in this condition.

The self-sufficiency of primitive muscle can be illustrated in many ways. A small piece of the intestinal wall, placed in Locke's solution, will contract for hours. The intestines have two beats: one called peristalsis, which occurs once or twice to the minute, and the second beat, which Mall called the heart of the portal circulation, occurring eighteen to twenty times to the minute. The slow contraction of the spleen at the end of the digestive period is the result of non-striated muscle tissue, together with a peculiarly unique arrangement of the elastic fibers of the capsule and trabeculæ of the spleen. Again, differential diagnosis between pregnancy and tumors in the lower abdomen can be made by means of the rhythmic contractions of the uterine body which can be felt with the hand. While the heart is composed of striated muscle, it is a most primitive type. The beat of the heart originates in the base of the organ. The impulses are collected in the sino-auricular node, a curious form of muscle tissue, and are sent through the muscle band of His to time the ventricular beat.

Hyperplasia, as well as hypertrophy, is an extraordinary attribute of the non-striated muscle, and in conjunction with its auto-controlled rhythmic action is responsible for the production of power in the work of fundamental functions. Increased work, backed by increased power of growth, is illustrated in the gastro-intestinal tract by the familiar examples of enormously increased musculature which works apparently without fatigue, as in the gastric musculature in cases of pyloric obstruction, and also in the intestinal wall in cases of intestinal obstructions. In this power of rapid growth lies the cause of the leiomyomata of which the so-called uterine fibroids are the most common.

THE EIGHT NEUROMUSCULAR NODES

In the process of digestion, the food passing into the œsophagus is beyond the control of the will. Impulses originating from the mechanical impact of the food in the œsophagus cause relaxation of the cardiogastric sphincter, permitting food to pass into the stomach. After the food enters the stomach, the rate and timing of its passage, as pointed out by Hurst, are due to reflexes which start in the transverse colon, progressively relax the ileocolic and pyloric sphincters, and start the peristaltic waves. The manner in which this is accomplished is shown by Keith, who discovered the nodal system, and more or less accurately located eight neuromuscular nodes which can be compared with the sino-auricular node of the heart, and may be said to act on the intestinal tract as pace makers as does the block system on a railway. The first node, at the beginning of the œsophagus, governs the œsophageal reflex. Impulses are carried from here to the second node which controls the cardia. Failure of this node to relax the cardiac orifice causes cardiospasm, as a result of which many persons have died unnecessarily of starvation because the obstruction was believed to be malignant. The third node is at the termination of the primitive foregut near the common duct, the site where Ochsner has pointed out evidences of the remnant of a rudimentary muscle. This explains the occasional birth of a child with complete stricture at this point. Disturbances of this node produce the condition known as pylorospasm.

The illuminating character of embryology in its illustration of clinical problems is found in the frequency of ulcer of the first portion of the duodenum and forces on us the realization that fundamentally the first portion of the

duodenum, while it has the form of the intestine, biologically is part of the stomach, having its origin in the primitive foregut and receiving its blood supply from the cœliac axis. The fourth node demonstrated by Keith is near the duodenojejunal angle, and is related to those not infrequent cases of gastromesenteric ileus which we have only recently learned may assume a chronic and relapsing form instead of the acute and sometimes fatal vicious circle. The fifth node is at the ileocæcal juncture and is concerned in the intestinal stasis of which Lane has written so interestingly. The sixth node is located at the middle of the transverse colon which marks the termination of the primitive midgut. Here again, embryology explains why absorption takes place in the right half of the colon which, like the small intestine, is supplied by the superior mesenteric vessel, and not in the left half of the colon which is supplied by the inferior mesenteric artery, and by antiperistaltic action keeps the food in the right half for absorption. The cæcum, ascending colon, and the right half of the transverse colon are fundamentally part of the small intestine and in the fetus have villi, the counterpart of those continued in the ileum and jejunum. After birth there is a change in form but not in function.

We know that the fluids which float the food products through the small intestines are largely absorbed in the head of the colon. Reasoning from the analogy of the huge cæcum and ascending colon of the herbivorous animal, it may be assumed that the proximal half of the colon was essentially intended for carbohydrate fermentation. Possibly some of the difficulties which Lane believes are the results of bands of adhesions may be due to increase in flesh consumption, the end products of which undergo putrefaction resulting in the development of poisons which are thrown into the head of the colon converting it into a cesspool. The seventh node is at the rectosigmoid juncture, and failure of function at this point has to do with giant colon, or Hirschsprung's disease. The eighth node is concerned with rectal control. All these nodes are connected with the autonomic system by nerve fibers.

THE INTERNAL SECRETIONS

While we recognize the autocontrol of the non-striated muscle and believe that the stimulation which results in intestinal peristalsis, for example, is largely mechanical, this power of originating muscular actions is closely related to and influenced greatly by another form of more generalized co-ordination which is best understood under the general title of internal secretions. Vincent, one of the most able of the investigators in this field, very justly says that the use of the terms *endocrines* and *endocrinology* is camouflage of ignorance, as though giving a less expressive name derived from a dead language, in some mysterious way helps to elucidate a subject as yet little understood, and he comments, as has Cushing, on the extraordinary vogue which theorizers with few facts and great imagination have given the subject. Starling asserts that the internal secretions antedate all forms of nervous systems. It is interesting to note that the alliance between the sympathetic nervous system and the glands of internal secretion is relatively close. All important glands of internal secretion which take part in co-ordinated control are closely associated with the sympathetic system; for example, the pituitary, in which the posterior lobe is closely related in structure to this system. The adrenals exhibit the same peculiarity. One might say that the chromaffin cells of the adrenal and other ganglions are, in reality, nerve cells of a type which suggests that in their inception they are associated with an entirely different kind of nervous system from any that now exists in man, and later become incorporated with the sympathetic nervous system. Certain important glands of internal secretions, the testicle and the pancreas, have both internal and external secretions. The testicle has, besides the secretion containing spermatozoa, the secretions of the interstitial cells which control sex characteristics. The pancreas is another example of glands having external and internal secretions, in relation to digestion on the one hand and the effect of the islands of Langerhans on the metabolism of sugar on the other. The thyroid in the King scorpion is associated in function with reproduction and its connection

with puberty in the human being is evidenced by the thyroid enlargement in girls. There have been found types of lower life in which the thyroid functions with digestion. The foramen cæcum at the base of the tongue in a man marks the site where this secretion was, at one evolutionary period, discharged into the intestinal tract. The thyroid finally became the gland which controls the output of energy in man.

THE AUTONOMIC NERVOUS SYSTEM

No study of the co-ordinating power of the non-striated muscle and the internal secretions would be complete without an understanding of the sympathetic nervous system as represented by the great sympathetic ganglions of the thorax and the abdomen. We are indebted to Gaskell for the most illuminating researches in this field. He pointed out that certain small-calibered, medullated nerves pass from the anterior horns of the spinal cord to the great sympathetic ganglions and that this communication is direct from the cord to the ganglions, with the single exception of the adrenals, through which certain nerves pass en route to the ganglions, connecting the sympathetic system with the chromaffin cells in the adrenals. From the great sympathetic ganglions, small, non-medullated nerves pass to all parts of the body, usually along the blood vessels, to control the production of instantaneous and widespread actions. In the emotions of anger and fear, Cannon corroborated the finding which shows that these fibers release the sugar reserves of the liver into the blood stream, and put the body instantly in a condition for defense. The gastro-intestinal digestion stops, and the movements of the non-striated muscles are held in abeyance. The heart action is increased to withstand the shock of physical combat; the pupils of the eyes dilate to permit wider vision. The skeletal muscles simultaneously are made ready for action under the control of the central nervous system. When the necessity for these defense manifestations has passed, the parasympathetic nerves described by Gaskell and Langley restore the normal condition. The most important of these parasympathetic nerves are the vagus, a small-calibered, medullated, cranial nerve, which reduces action of the heart and respiration and sets in motion the gastro-intestinal tract, and the pelvic nerve, which permits emptying of the bladder and rectum that has been temporarily in abeyance. The parasympathetic nerves are peculiar in that they have ganglion and nodal cells at their termination, for instance in the non-striated muscle of the intestinal wall, as Auerbach's and Meissner's plexuses. Carlson, the eminent physiologist, says that while some important facts are known, the exact relationship of the autonomic nerve fibers in a given nervous disturbance is by no means settled. He comments adversely on the use of the terms *vagotonia* and *sympatheticotonia* as though they represented assured and positive, instead of vague and little known, conditions. Langley speaks of the combined sympathetic and parasympathetic nervous systems as the autonomic system. For the sake of better understanding of the autonomic system the internal secretions and the non-striated muscle should be included with the sympathetic and parasympathetic systems under this head.

THE CENTRAL NERVOUS SYSTEM AND THE VEGETATIVE FUNCTIONS

We are just beginning to awaken to the knowledge of the relation of the fundamental sciences to clinical medicine. The two oldest functions of a living body are maintenance of nutrition and reproduction, and these two functions are surrounded by many safeguards. The more ancient the heredity of any part of the body, the greater its inherited resistance. For instance, the testicle is the ancient reproductive organ, and it has few diseases; its rare tumors are usually teratomata. Contrast the testicle with the ovary in this respect. The ovary is descended from the testicle, is of more recent origin, and develops many kinds of tumors and other lesions. New growths of the ancient small intestine are rare as compared with those of the stomach, the large intestine, and the rectum. We can safely say that the vegetative functions, being older in point of heredity, are more stable and better organized than the more recently acquired central nervous system which is sub-

jected to the many emotional influences which we speak of as pyschic, and which through Gaskell's nerves may influence unduly the autonomic control and co-ordination of the vegetative functions. In the unstable individual these functional disturbances may be so exaggerated as more or less to resemble pathological processes which are accepted by the patient and the unenlightened as true, although known by the trained observer to be false. Herein lies the success of the cults and quackeries. The fundus of the stomach came into existence after the central nervous system was developed. By reason of the central nervous system, man has some knowledge of what goes on in the fundus of the stomach, but little or no knowledge of what occurs in the intestinal tract, until the sigmoid colon is reached, except as the information comes from the stomach. Food does not leave the stomach of its own accord. If there is interference with intestinal peristalsis, food remains in the stomach too long and there results gastric indigestion, so-called dyspepsia, recognized now as a secondary phenomenon, but formerly regarded as an indication of gastritis or disease of the stomach itself. The designation of indefinite pathological conditions by such terms as *achlorhydria*, *hyperchlorhydria*, and *achylia gastrica*, which in reality merely indicate symptoms, is unwarranted and deplorable.

Again, the progress of the food intake is greatly influenced by somatic disease. Patients with tabes have had gastro-enterostomies performed, or the gall bladder removed, for gastric crises. The anorexia of the hysterical state is universally recognized. Tuberculosis is often ushered in by gastric symptoms, in the useless treatment of which much precious time is lost. The masquerading dyspepsias of heart disease, pernicious anæmia, and chronic nephritis too often lead to loss of valuable time before correct diagnosis is made and proper treatment instituted. The dyspepsias associated with gall stones, appendicitis, and obstructed hernia are equally pertinent instances. The fundus of the stomach can be compared to a branch telephone office in which the relaying of messages to the central station, the brain, is misinterpreted. As Finney points out, the relatively late development of the sigmoid is well shown in its varying length and position, and in the fact that the brain becomes more or less conscious of the sigmoidal state. Cabot remarks that mucous colitis is a disturbance of the nervous system, evidenced by the passage of quantities of mucus, leading to much complaint and frequent examination of the stools by the patient. While it has been customary in the past to regard the atonic stomach, visceroptosis, and the position of the uterus as mechanical factors of great importance in the production of neuroses, less emphasis is placed on these conditions at the present time, since a better understanding of the autonomic nervous system has been gained. The large majority of these baffling phenomena concern the fundamental functions of the maintenance of the body, and reproduction (Freud's morbid theories) in relation to the central nervous system. We recognize that thought is the product of a material substance, the brain, but because we cannot see the thought we treat it as non-existent. Bodily fatigue is the result of the inability of the exhausted tissues to burn glucose sugar with sufficient rapidity, and to rid themselves of the products of combustion. Rest restores the oxygen balance, and food furnishes the carbonates which prevent exhaustion acidosis. Fatigue of the emotions, so-called neurasthenia, concerns mentality and we know very little about it. Peabody says that neurasthenia is, to a great extent, a disease of the idle rich. We may well say that contented industry is the wellspring of human happiness. The economic status of the patient is not so directly concerned with the more common types of the so-called neuroses which are fixed-tissue delusions on the general principle of, "If you believe it, it is true." These unfortunate conditions are true to the patient, whether or not they are true to the diagnostician.

Sherington, in his presidential address on mentality before the British Association, said that the special office of the central nervous system is to bring the bodily component parts into harmonious mechanism which will react as a unit to the world around us.

He comments on the fact that what lifts man above the beasts is mentality, located in the more recent additions to the forepart of the brain, and points out that nervous conditions cannot well be separated from mental conditions, although between them there is the difference between night and day.

The query arises: Are not many, perhaps most, of these unstable nervous conditions, so-called neuroses, which are exploited by the cults and quackeries, the results of an attempt of the newer part of the central nervous system to take control of previously established co-ordinating functions, unrighteous attempts at control of the sympathetic ganglions, the internal secretions, and the primitive non-striated muscle by an unbalanced recent development of the forebrain?

SEMINAL VESICULITIS AFTER PROSTATECTOMY

By MONTAGUE L. BOYD, M.D., Atlanta, Georgia

THERE are two points about the seminal vesiculitis occurring after prostatectomy which deserve especial attention:

1. Acute inflammation of the epididymis after prostatectomy is evidence of an infection of the seminal vesicle.

2. Such a seminal vesiculitis may be the cause of symptoms ascribed to acute or chronic cystitis, posterior urethritis, and pyelitis.

It is generally admitted that epididymitis is fairly frequently seen after prostatectomy, but very little attention is given by most authors to this complication although at least one, Deaver (1), calls attention to its possible seriousness: "The least serious of the infectious complications, such as epididymitis, may be the deciding factor in causing the death of debilitated subjects." Deaver and Wade (2) both quote McDonald as showing epididymitis occurring in about 27 per cent of the cases before and after operation, and Legueu (3) speaks of 12 to 15 per cent.

The evidence from which I have drawn my conclusions that seminal vesiculitis occurs in these cases and produces symptoms which can be relieved by suitable treatment is: First, in four of my prostatectomy cases epididymitis occurred in connection with a seminal vesiculitis which was demonstrated both by rectal examination and a study of the seminal vesicular secretion. Second, for the past few years I have made a rectal examination and a study of the seminal secretion in every case of acute non-tubercular epididymitis, and I have found in every case the corresponding seminal vesicle infected, usually distended, and containing a good deal of pus and organisms. Luys (4) is the only author I have found who mentions this. Not infrequently it was a little difficult to empty the seminal vesicle by the use of the gentle pressure which I believe should be employed in such cases, but as soon as the vesicle was emptied the patients very frequently volunteered the statement that they were greatly relieved of the discomfort or pain in the lower abdomen, and in the region of the inguinal canal, and sometimes in the testicle and epididymis. Furthermore when the vesicle was emptied before the epididymitis became extensive, the process was halted and the swelling rarely extended beyond the lower part of the epididymis. Of course, exceptions occurred but they have not been sufficiently frequent to detract from my conclusion concerning the benefit to be derived from the procedure.

I am convinced then that in practically every case of epididymitis we have an accompanying infection of the seminal vesicle which in most instances should receive some treatment other than that usually employed for the epididymitis occurring after prostatectomy.

It is not my desire to exaggerate the seriousness and importance of seminal vesiculitis in these cases, but rather to call attention to its fairly frequent occurrence and to try to offer a few suggestions about its prevention and cure, more especially in suprapubic prostatectomy

cases since, though the complication occurs fairly frequently after perineal prostatectomy, a different set of conditions exist there which require a somewhat different handling.

It is true that in some instances the seminal vesiculitis requires no attention for the epididymitis subsides, the fever disappears and the urine becomes in time free from pus and infecting organisms.

In other cases the epididymitis does not subside readily and even epididymotomy at times is necessary. In such cases, and also in some others where the epididymitis is absent or not so annoying, a fairly active infection of one or both vesicles can be demonstrated.

Very naturally it is not necessary to have an inflammation of the seminal vesicles in every case of epididymitis, as it need not occur where an ejaculatory duct is torn so as to separate the vas from the seminal vesicles. But, whatever the method, I feel sure that freedom from inflammation is the exception and not the rule, for I have invariably found the corresponding seminal vesicle infected.

It is far more frequent, I believe, to have an infection of the seminal vesicles, even with an involvement of the ampulla of the vas, without an accompanying epididymitis, and these are the cases in which the vesiculitis is most readily overlooked, even though it gives other less evident symptoms of its existence.

ETIOLOGY

A case which I reported in 1920 before the Fulton County Medical Society, and which will be published very soon in the *Journal of Urology*, is of considerable interest in connection with this paper illustrating the possibility of the seminal vesicles becoming infected before prostatectomy. It is hardly necessary to refer most urologists to this case because nearly every one has seen the development of epididymitis in prostatic hypertrophy cases in which catheterization has become necessary and an infection has spread through the ejaculatory ducts from the posterior urethra. The pre-operative study in these cases is rarely, if ever, made with the idea of determining the presence or absence of a seminal vesiculitis. The investigator is usually satisfied to discover whether there are evidences of urinary infection and whether or not the patient requires an operation, but, I dare say, that if vesiculitis were looked for we would find it more frequently than is now generally believed. Proof of this, if needed, can be found in the various articles on prostatectomy in which the frequency of epididymitis occurring before operation is reported.

It is not unnatural to expect varying degrees of infection of the prostate wound in cases with infected bladders. It is hardly likely that a wound of such a nature, bathed so freely by infected urine, could heal without at least some superficial infection taking place. Unfortunately, varying degrees of infection occur also in most of the cases in which the bladder was infection-free before operation. This statement is verified by observing that the urine in practically all prostatectomy cases is more cloudy in the first glass and contains pus and bacteria for longer or shorter periods after closure of the abdominal or perineal wound.

The most common origin then, though by no means the only one, of the postoperative seminal vesiculitis and epididymitis is probably an extension of an infection from the prostatic wound. The course naturally is through the ejaculatory ducts to the seminal vesicles and ampulla of the vasa and then to the epididymides.

The ease with which this extension occurs depends partially upon such things as the type of infecting organism and the patient's resistance to infection. But, it also depends upon the amount of trauma to which the seminal vesicles and vasa were subjected during the operation; upon the extent of injury to the ejaculatory ducts and their surrounding tissues and upon the character of the wound which is left when the hypertrophy is removed. Indirectly it depends upon unobstructed urinary drainage from the bladder more especially during the first week or ten days after operation, since distention of the bladder during this period might in the first few days after operation cause extravasation about the wound, and, sooner or later, either force infection through injured ejaculatory ducts, or, by preventing free drainage of the wound, intensify infection there and thus assist in extension of the infection.

SYMPTOMS AND DIAGNOSIS

The prostate wound well might produce symptoms which could be mistaken for seminal vesiculitis and vasitis. During the first few weeks of the convalescence, the fact that we are willing to refer all symptoms to the wound, causes the seminal vesiculitis to be overlooked, or at least ignored; and unfortunately a plan for clearly differentiating the outstanding symptoms of each has not been outlined. However, I believe that, by a careful study in each case, some of the symptoms can be differentiated. When epididymitis occurs, we need no further evidence to prove the existence of an acute vesiculitis. A nagging pain in the lower part of the abdomen, rectum, or testicles, is more apt to be from the vesicles and vas than from the wound. Fever could be produced by an infection of either the wound or of the vas and vesicles, but intermittent attacks of fever, often accompanied by slight chills, are more likely to be from the latter. In at least one of my cases, the vesiculitis was mistaken for a pyelitis and I feel sure that in the future the discovery of such an existing infection will explain for me some of the elevations in temperature which I attributed to pyelitis or recorded as unexplainable.

Later in the postoperative course, the evidence of a continued vesiculitis is found in the products of inflammation coming from the posterior urethra, as pus, mucus and, at times, organisms, in such quantities and for such a length of time as one would not expect to obtain from an uncomplicated prostatic wound inflammation. These products the more easily gain entrance to the bladder through the relaxed or partially relaxed vesical orifice, and since, they are mostly found there, until urination begins they must of course be differentiated from those coming from bladder disturbances and from kidney infections.

A definite diagnosis can usually be made in the later convalescence by rectal examination and a study of the seminal vesicular secretion expressed by massage.

PREVENTION

For the prevention of postoperative difficulties with seminal vesiculitis, it would probably be well to examine the seminal vesicles of all cases coming up for prostatectomy so that a seminal vesiculitis would not be overlooked and, in selected cases, treatment could be administered with the idea of at least improving the condition before the operation.

The general measures now in use for getting prostatectomy cases in condition for operation serve the purpose of increasing their resistance and lessening postoperative complications. One suggestion, however, might be added, namely, that one of the safest methods of washing out the posterior urethra in catheterization cases is to have the patient void. Though they can pass only a small part of the urine, they should be encouraged to do so at least once or twice a day before the introduction of the catheter. Even the infected urine, if it is acid and contains some of the urinary antiseptics or their products, is of some cleansing value for this purpose. The procedure would be of greater value if the bladder were filled through a catheter with warm boracic solution, and the patient allowed to void, and then with the catheter reinserted, to empty the bladder.

Vaccines may be of value, but I do not feel that my experience is extensive enough to warrant my approving or disapproving their use. The consensus of opinion has been, I believe, that they are rather ineffective in most genito-urinary infections but, unless given in overdoses, they would be apt to do good rather than harm.

The type of infection can be controlled to a certain extent in cases with alkaline urine by giving acid sodium phosphate and injecting lactic acid bacilli into the bladder. For cases with other types of infection, the routine urinary antiseptic given by mouth, the bladder irrigations and instillations commonly advocated can be most certainly of some service in preventing troublesome postoperative infections of the wound.

Of whatever importance these measures may be we have perhaps still as important ones to consider.

The character of the wound left after prostatectomy depends not only upon the operator's skill but also upon the size of the enlargement, upon whether it was largely periurethral or mostly intravesical and upon

how much difficulty was experienced in freeing the hypertrophy from the surrounding tissue, or we might say upon how adherent the hypertrophied tissues were to the surrounding tissues; and upon how tightly the vesical orifice contracts after the prostate is removed.

For the most advantageous results in healing, the prostatectomy wound, like all other wounds, demands that surrounding tissues be bruised or injured as little as possible, that no devitalized tissue or pockets in which infection can be harbored be left in the wound, that no infectious material be drained into it, that free drainage be supplied continuously and that it be kept clean.

It is difficult in every case to prevent bruising of the tissues about the hypertrophy, but every effort should be made to produce as little injury as possible, not forgetting the bruising which the finger in the rectum may cause. With the attention concentrated upon the work of the enucleating fingers, it is not unlikely that unnecessary force will be employed by the fingers in the rectum when the other hand is straining to overcome unusual difficulties. The seminal vesicles and ampullæ of the vasa usually lie between the rectum and the hypertrophied prostate and are therefore in position where they can be readily injured by unusual roughness.

Since undamaged ejaculatory ducts serve better to keep out infection, their position in relation to the hypertrophy should be kept in mind, and when the necessary careful survey of the contour of the hypertrophy is made, with the finger introduced into the bladder, before beginning the enucleation, an effort should be made to locate the verumontanum so that when possible the urethra can be torn in such a way as to prevent, as far as possible, injury to that part of the urethra through which the ejaculatory ducts run. In some cases I know that it is possible to tear through the floor and lateral walls of the urethra just vesicalward from the verumontanum before beginning the enucleation, thereby preserving the urethra about the ejaculatory ducts better than can often be done by the usual intra-urethral enucleation.

To assist in locating the verumontanum at operation the distance between the outer part of the intravesical projection of the hypertrophy and the verumontanum can be noted at the routine cysto-urethroscopic examination made before operation.

To keep such an inaccessible wound clean after operation is naturally not easy. Direct lavage can best be obtained by the introduction of a small catheter through the urethra to just beyond the external sphincter, allowing the irrigation fluid to flow back into the bladder through the internal sphincter. This should be employed as a routine. It can be done safely and satisfactorily provided the vesical sphincter has not contracted sufficiently to require force to cause the irrigation to flow through it. Where this contraction occurs, instillations of suitable antiseptic solutions through the urethral catheter should be substituted for irrigations; and the bladder should be irrigated through a small catheter passed through the suprapubic wound, the irrigating fluid flowing back around the wound.

Where the sphincter has not been injured at operation or overstretched by the intravesical projection of the hypertrophy it may close sufficiently to prevent not only satisfactory lavage of the wound from the urethral side but also the free drainage of the wound into the bladder which is the only drainage supplied in the suprapubic prostatectomy cases. In a paper read at the 1922 meeting of the Southern Medical Association, I briefly called attention to the difficulties which might arise as a result of the early contraction of the vesical sphincter. In the discussion, Dr. Arthur Chute remarked that he saw no reason for preserving this sphincter in suprapubic prostatectomy and rather advocated severing it so that the prostatic wound would lie open and thus be freely drained into the bladder. Certainly this might in certain cases supply the free drainage that good surgical technique demands and, it is true, that while the preservation of the internal sphincter is often necessary to prevent fistulæ or incontinence in perineal prostatectomy cases when the prostatic urethra is opened and the membranous urethra injured, it is really not necessary to preserve it in suprapubic prostatectomies when the external sphincter is not injured and the perineal fistulæ are not found.

In the light of the findings of Young and Wesson (5) concerning the vesical sphincter and the trigone, we do not have a true sphincter remaining to produce this closure about the vesical orifice, but posteriorly, an hypertrophied trigone and laterally the muscle fibre of the longitudinal layer of the bladder. In the suprapubic enucleation of a large hypertrophy with an intravesical protrusion, the circular fibers which assist normally in the formation of the sphincteric action, would frequently be torn across. This would leave us a choice of cutting posterior-laterally through longitudinal layers of fibers or behind through the abrupt termination of the usually hypertrophied trigone.

So far I have not tried this, but I am convinced that some method of overcoming such a pocket-like formation is needed unless we can prevent troublesome infections developing there by employing instillations of small quantities of suitable antiseptics such as mercurochrome and acriflavine. I have been using these two in my few recent cases and I believe they have done some good.

In addition to the measures outlined for preventing the development of the severer infections in the prostatic wound and their extension to the vasa and vesicles, I wish to emphasize the importance of maintaining free drainage of urine from the bladder until the prostatic wound has had time to heal. Should the bladder become distended the urine, of course, would be forced back into the wound and extravasation probably occur. Therefore, the abdominal wound should be left well open and a good sized tube leading to the bladder left in it. In a case to which I have referred in another paper the lips of a 24 hour old wound healed together in a few hours after the tube was removed in such a fashion as to cause the patient's bladder to fill and permit voiding. Such accidents are not infrequently followed by very annoying infections in and about the wound with very likely an extension of the infection to the seminal vesicles and epididymes.

The most effective treatment of post-prostatectomy acute seminal vesiculitis would be to empty the seminal vesicle by gentle pressure with the fingers in the rectum. But there are in these cases two conditions which do not exist in other cases of seminal vesiculitis and which make such massage not only more difficult but perhaps even dangerous when attempted soon after operation. They are the higher position in the pelvis of the seminal vesicles in prostatic hypertrophy cases and the presence of thrombi in the periprostatic veins.

If the lateral and middle lobes are much enlarged the ejaculatory ducts are considerably increased in length and the seminal vesicles lie high up in the pelvis. If the prostate is normally situated high in the pelvis (high as related to the ability to reach it by rectal palpation) and the hypertrophy has carried the vesicles still higher, massage is out of the question. But, regardless of their position, any rectal manipulation must be carried out with the greatest care when made shortly after the operation on account of the danger of breaking off parts of thrombi which may have formed in the veins which are normally so abundant about the prostate, particularly on the ventral surface, and when any difficulty is experienced in carrying out this method of treatment, it had better be deferred until later in the convalescence. Just how long after the operation before this risk of producing emboli becomes negligible I cannot say, but I do know that in many cases the seminal vesiculitis continues to exist unless curative treatment is instituted. Later on, then, in the convalescence, massage of the seminal vesicles should be begun and the condition treated very much as any non-tuberculous seminal vesiculitis is treated. Bladder and urethral irrigations should be used, but it is much better to wash out the urethra by having the patient void after filling the bladder with an antiseptic solution than to force the solution back through the urethra with hydraulic pressure. Hot rectal irrigations are helpful. Instrumentation of the urethra with sounds and Kollmann dilator will probably be found useful and in persistent infection vasotomy with injection of the seminal vesicles may become necessary.

Finally in view of the difficulties in treating acute seminal vesiculitis in these cases, and the inconvenience and, as the case may be, the more or less serious consequence of its occurrence, we should make a greater effort

than is now being made to prevent its development. We should recognize its appearance sooner and more frequently, and develop new methods of prevention and treatment.

SUMMARY

Though some attention has been given to the prevention of infection and treatment of infected prostatic wounds, the importance of postoperative acute and chronic seminal vesiculitis has been disregarded. This condition occurs most often through an extension of an infection from the prostatic wound, though not infrequently a chronic infection exists before operation.

Epididymitis, which is practically always the extension of an infection in the seminal vesicles and vasa, has been treated as an independent complication.

Such a vesiculitis is capable not only of producing, in the acute stages, an epididymitis but also of causing chills and fever. At times even high elevations of temperature are found, either intermittent or continuous, which are frequently ascribed to pyelitis, cystitis, or infections of the prostatic wound. Pain or discomfort in the lower sides of the abdomen, in the testicles, perineum, or rectum are generally present. The chronic vesiculitis usually keeps up a posterior urethritis and in this way or by itself causes discomfort on, and an increased frequency of, urination.

In making a diagnosis in the early postoperative period, one must recognize the difference between the symptoms arising from the prostatic wound and those from the vesiculitis. In the postoperative stage the diagnosis is made by the urine, when voided; by the local and referred pains and discomforts, and by rectal examination and a study of the seminal vesicular secretion obtained by massage. An epididymitis is at all times sufficient evidence of the existence of a vesiculitis.

The means of preventing this complication are:

1. Before operation. Infection of the vesicles is avoided by suitable treatment of inflammation of the bladder and urethra, treating, as far as possible, all seminal vesicular infections before operation. Infections of the bladder and posterior urethra are treated so that they will cause as little trouble as may be after operation. The usual method is employed of improving the patient's physical condition and increasing his resistance to infection.

2. At operation. When possible the posterior part of the prostatic urethra is torn across before beginning the enucleation so that the urethra about the ejaculatory ducts will be injured as little as possible. The operator should avoid bruising the periprostatic tissues, ejaculatory ducts, and seminal vesicles by unnecessary roughness from the rectal and enucleating fingers. He should leave no devitalized tissue in the wound. At times, perhaps, incision is made of the diaphragmatic-like collar resulting from the more or less immediate resumption of function of the vesical sphincter which causes the prostatic wound to be closed in and to lack the free drainage which would seem desirable.

3. After operation. Free bladder drainage prevents distention of the bladder which is apt to cause extravasation about the wound, severer infections of the wound, seminal vesiculitis, epididymitis, etc. Irrigation of or instillations into the prostatic wound and bladder is suggested.

Although the emptying of a seminal vesicle by massage is indicated whenever an acute, non-tuberculous, descending epididymitis occurs, it must be recognized as a difficult and even dangerous proceeding in these cases when attempted shortly after operation and should be attempted only by those well trained and skilled in this procedure.

Some weeks after operation, however, there is less danger, and massage of the vesicles, irrigations of the urethra and bladder, hot rectal irrigations and, in some cases, instrumentation of the urethra and injection of the vesicles by vasotomy should be employed.

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THE PATTERN OF WEAKNESS OF THE HAND IN ULNAR AND MEDIAN NERVE LESIONS

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DUAL innervation of muscles, synergistic muscular supply, and supplementary movements make the interpretation of the degree of injury to the ulnar and median nerves difficult. Particularly difficult is the interpretation of weakness in the thumb and fingers.

Dynamometric examinations of the phalanges were made in a considerable number of cases of injuries to the ulnar and median nerves and a review of a number of available records of these examinations has been productive of a few conclusions seemingly worthy of report.

The strength of a movement of any of the phalanges was ascertained by a spring scales, registering pounds or grams.

The figure obtained was marked upon an imprint of the hand in its appropriate place. This method of examination and recording has been found to be very satisfactory in affording a comprehensive and accurate description of motor power (Fig. 1).

Fairly complete records of 86 cases were found. Of these, 28 were cases of injury to the median nerve, 33 to the ulnar nerve, and 25 to the ulnar and median nerves combined.

The cases of injury to the median nerve may be divided into four groups and analyzed as follows:

1. Four anatomical sections confirmed at operation. Sensory loss was complete, the isolated supply of pain sense of the median nerve being interpreted as the distal and part of the second phalanx of the index and middle fingers.[1] Great weakness or paralysis in the distal two phalanges of the index finger and varying strength in the phalanges of the middle fingers was found. Movement of the distal phalanx of the thumb was practically absent.

2. Twelve severe lesions were found at operation not to be anatomical sections. In general these showed greater strength of the index finger, but in three no difference from cases of anatomical section could be seen. Otherwise, phalangeal movements of the fingers were of no value in interpreting the degree of injury. Flexion of the distal phalanx of the thumb was weak but greater in strength than in the first group in 7 cases. The second phalanx of the thumb was stronger in 8 cases and not recorded in 1 case. Sensory loss was incomplete in all.

3. There was 1 case of severe but incomplete lesion with slight sensory recovery but little movement in the thumb, and definite contraction of the palmaris longus.

4. There were 11 cases of recovering or partial lesions not operated upon. In general the movements of the phalanges of the index and middle fingers were stronger. The opponens pollicis showed recovery in 4 and the flexor carpi radialis in 3. In only one instance was the sensory loss complete.

In 23 of 24 incomplete lesions, sensory regeneration, interpreted in terms of isolated supply, had begun. In only 1 case was there evidence of motor regeneration in the absence of sensory recovery (Fig. 2).

The ulnar nerve injuries were as follows:

1. Eight cases of complete anatomical section verified by operation. The weakness in

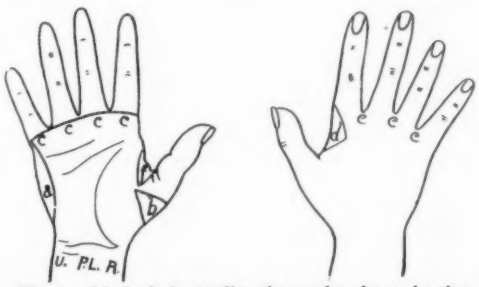

Fig. 1. Method of recording the results of examination: The positions indicated by the various letters denote the following muscles: *a*, hypothenar muscles; *b*, opponens pollicis; *c*, lumbricales; *d*, first dorsal interosseous; *e*, remaining interossei; *f*, adductor pollicis; *u*, flexor carpi ulnaris; *p-l*, palmaris longus; *r*, flexor carpi radialis.

[1] Pollock, L. J. Overlap of so-called protopathic sensibility as seen in peripheral nerve lesions. Arch. Neurol. & Psychiat., 1919, ii, 667-700.

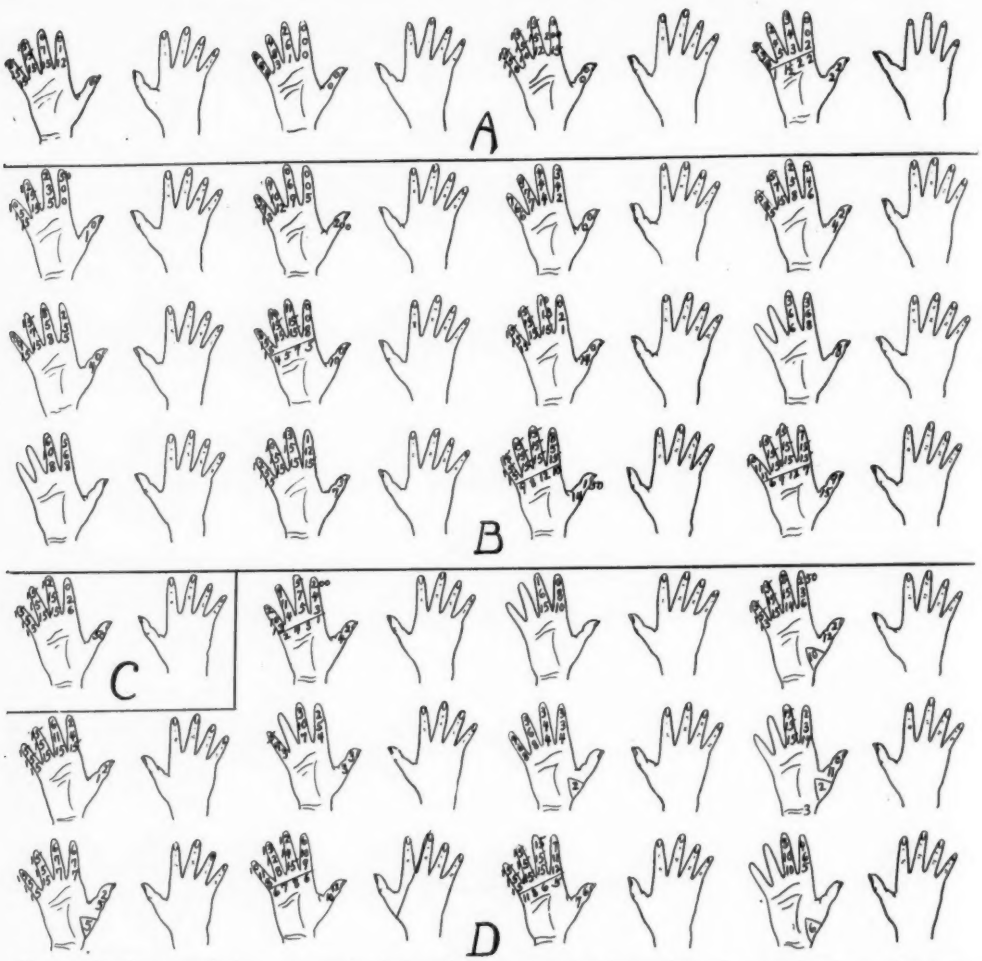

Fig. 2. Median nerve lesions: *A*, anatomical section confirmed at operation, sensory loss complete; *B*, severe lesion not anatomical section, confirmed by operation, sensory loss incomplete; *C*, severe but incomplete lesion, marked sensory loss; *D*, recovering or partial lesion, sensory loss complete in *only one*.

the two inner fingers varied greatly; at times as much as 5 pounds of flexion in the proximal phalanges was observed (but never when the distal phalanges were extended).

Lateral movements of the fingers were very feeble with the exception of the index finger where the first interosseus received some supply from the median. The sensory loss was complete.

2. Severe lesions, not anatomical sections. Although the strength of the little finger was frequently greater than in Group 1, in 4 the difference was inappreciable. In 2 the strength of the proximal phalanges was definitely greater. The strength in the ring finger in general was greater than in complete lesions but not with sufficient constancy to be of absolute prognostic value. Sensation was completely lost.

3. Six cases of compression with only partial sensory loss. In 2 there was practically no loss of power in the phalanges, in 1 greater

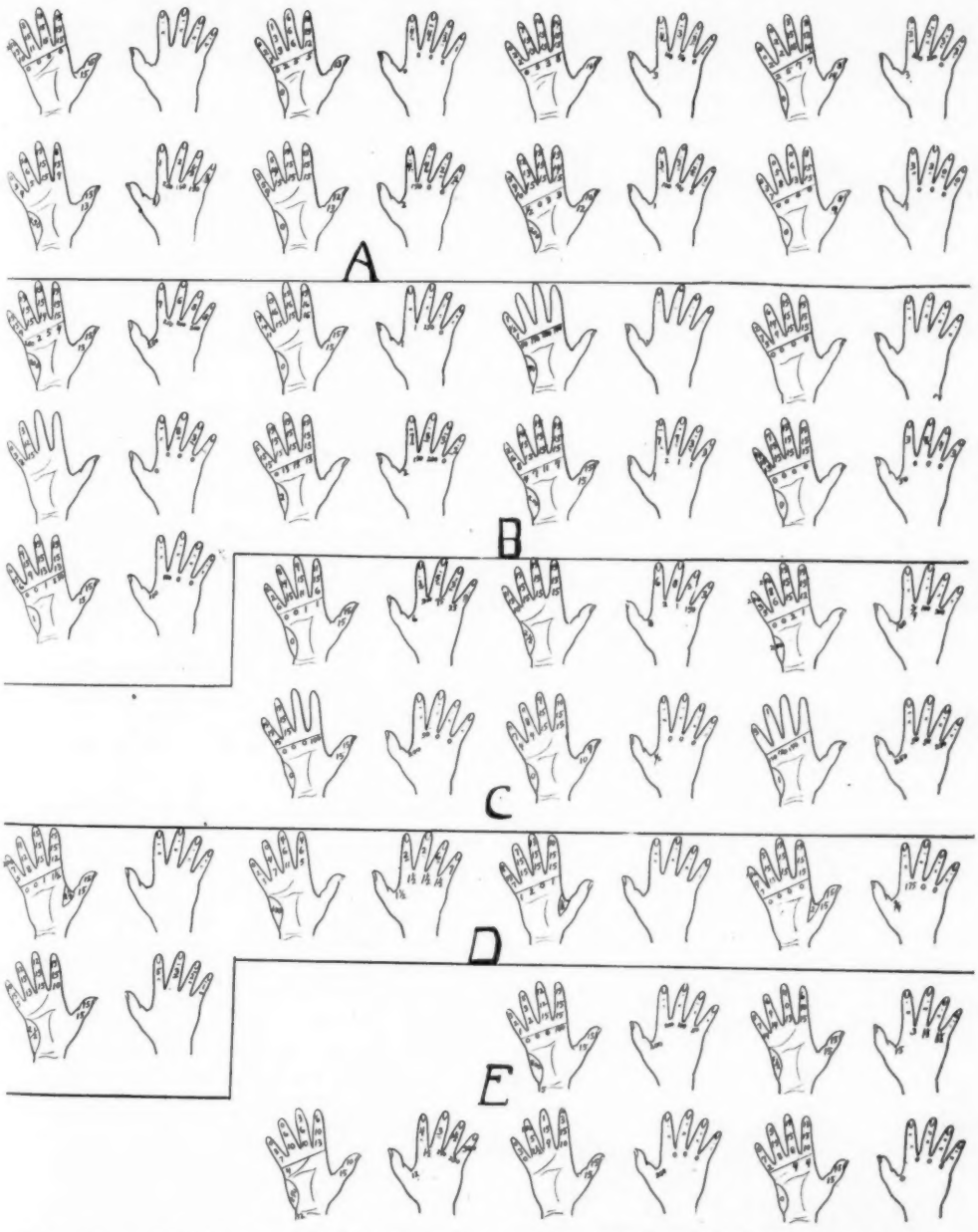

Fig. 3. Ulnar nerve lesions: *A*, anatomical section verified at operation, complete sensory loss; *B*, severe lesion not anatomical section, complete sensory loss; *C*, compression of ulnar nerve, verified at operation, partial sensory loss; *D*, partial and recovering lesion not verified by operation, complete sensory loss; *E*, cases similar to *D* with some sensory regeneration. Only 4 cases showed sensory regeneration in the absence of motor recovery.

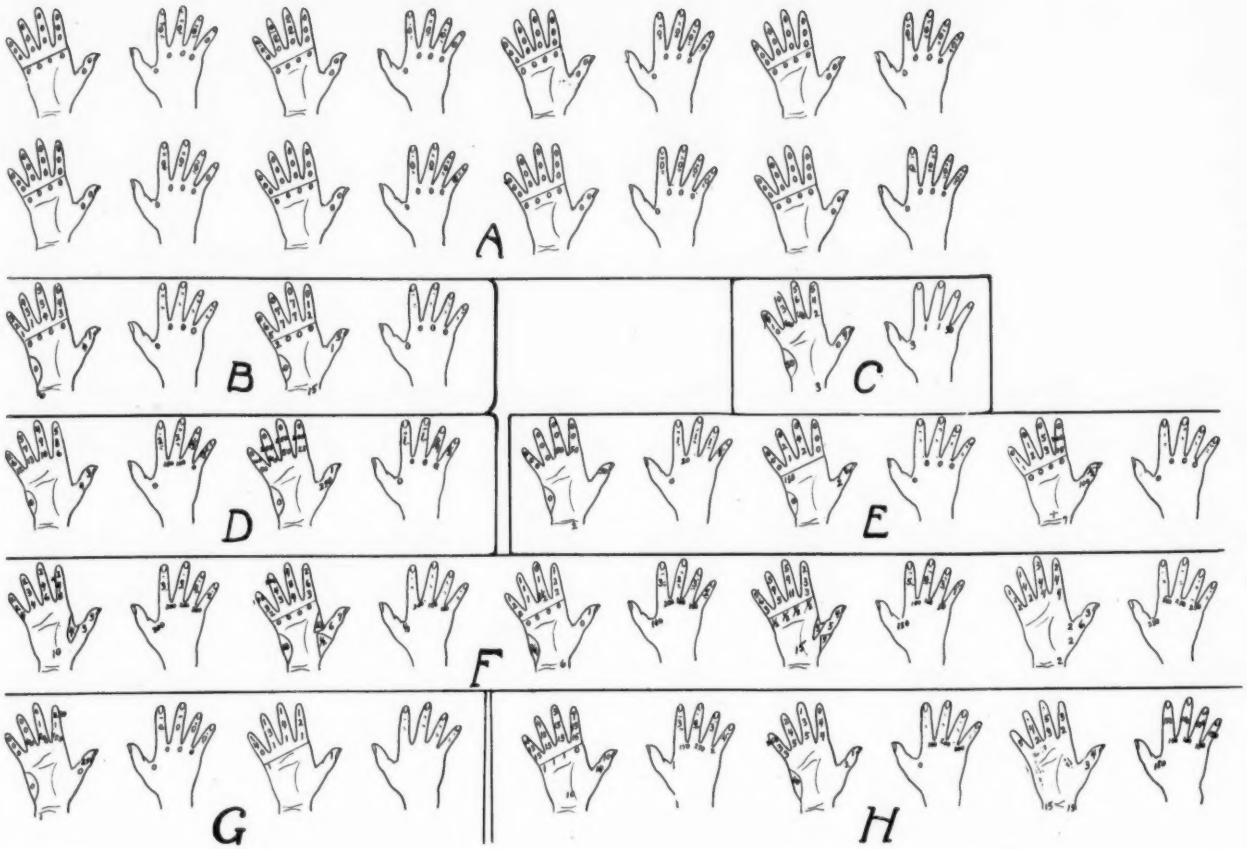

Fig. 4. Ulnar and median nerve lesions: *A*, anatomical section, complete sensory loss; *B*, incomplete but severe lesion; complete sensory loss over ulnar; incomplete over median; *C*, incomplete but severe lesion, incomplete sensory loss over ulnar and median; *D*, incomplete but severe lesion, complete sensory loss over ulnar and median; *E*, complete ulnar, incomplete median, sensory loss over ulnar complete, over median incomplete (all above group confirmed at operation); *F*, incomplete or recovering lesion, sensory loss over ulnar complete; no loss over median in three and only partial loss in two; *G*, complete ulnar analgesia and incomplete sensory loss over median with regeneration of ulnar nerve; *H*, incomplete ulnar and median nerve lesions; no sensory loss in ulnar; slight sensory loss in median.

strength in the first dorsal interosseus than in complete lesions (6 pounds), and in 2 greater strength in abduction of the little finger (one or more pounds) than in complete lesions. In only 2 was sensory regeneration present and motor recovery absent.

4. Ten cases of partial and recovering lesions not coming to operation. Of these, 5 had complete sensory loss; motor regeneration was shown by all, by relatively greater strength in the phalanges in 2, by return of power in the adductor pollicis in 3, by greater strength in abduction of the little finger than observed in complete lesions in 1.

The remaining 5 cases showed some sensory regeneration. In 3 of these there was definite return of some motor function; in the abductor minimi digiti and adductor pollicis in 1, and in the flexor carpi ulnaris in 2. The remaining 2 showed no difference in motor pattern from complete lesions.

Of 25 incomplete lesions, sensory regeneration could be demonstrated in 11 and of these 11, 7 showed definite motor regeneration. Only 4 cases showed sensory regeneration in the absence of motor recovery (Fig. 3).

The cases of injury to the ulnar and median nerves may be analyzed as follows:

1. Eight anatomical sections confirmed by operation. There were no movements of the phalanges and there was complete sensory loss.

2. Two cases of incomplete but severe lesions. The sensory loss was complete in the ulnar nerve and incomplete in the median. There was movement in some of the phalanges of all fingers and in the flexors of the wrist, flexor carpi ulnaris in 1, palmaris longus in 1, and palmaris longus and flexor carpi ulnaris in the other; in the first, movement of the second phalanx of the thumb; in the other, no indication of motor recovery of the ulnar was observed.

3. One case of incomplete but severe lesion, with incomplete sensory loss of both ulnar and median nerves. Movements of phalanges of all fingers, strong flexion of second phalanx of thumb, and fairly strong adduction of thumb.

4. Two cases of incomplete but severe lesions with complete sensory loss of ulnar and median nerves. There was movement of all the phalanges: in one, flexion of the distal and second phalanx of the thumb and strong flexion of the proximal phalanges of the little and ring fingers; in the other, flexion of the second phalanx of the thumb but no indication of recovery of the ulnar.

5. Three cases of complete ulnar and incomplete median lesions. In all, the sensory loss of the ulnar was complete and the median incomplete. In 2, movement of the palmaris longus or flexor carpi radialis could be seen, in the other, strong flexion of the distal phalanx of the thumb was found.

All of the foregoing lesions were confirmed at operation.

6. Five cases of incomplete or recovering lesions of ulnar and median nerves. In all, the sensory loss of the ulnar was complete, in 3 there was no sensory loss in the median, and only partial loss in 2.

The abduction of the thumb had returned in 4, the abduction of the little finger in 1; the flexor carpi ulnaris in 1, the opponens in 3, the palmaris longus in 3, and the flexor carpi radialis in 2. The phalangeal movements were of no assistance in determining which of the two nerves were only partially injured.

7. One case at one time showed complete sensory loss in the ulnar and median and motor indication of partial injury to one or both nerves, or complete section of one and partial of the other. Two months later, there was complete ulnar analgesia and incomplete median, with return of power in the little and ring fingers and the first phalanx of the thumb.

8. Three cases of incomplete ulnar and median lesions. No sensory loss in the ulnar and slight loss in the median. One showed a return of movement in the little and ring fingers, two in the flexor carpi ulnaris, all in movements of the thumb, and two in the palmaris longus. In only one case was sensory regeneration present in the ulnar distribution when motor examination gave no indication of recovery.

In 15 of 17 cases of partial lesions of the ulnar and median nerves, the sensory loss of the median was incomplete. In only 4 of these seventeen cases was the ulnar sensory loss incomplete. In only 2 cases of severe but incomplete lesions of the ulnar and median

median, sensory loss over ulnar complete, over median incomplete (all median.

nerves was the median sensory loss complete and motor regeneration evident (Fig. 4).

COMMENT

a. *Ulnar nerve lesions.* Physiological interruption cannot be differentiated from anatomical section by the strength of movements of the phalanges of the fingers.

In recovering and partial lesions, relatively greater strength in the phalanges is observed but may at times be an inaccurate guide to the severity of the lesion. Relatively greater strength in the first dorsal interosseus, or in the abductor of the little finger, is an accurate guide as to the incompleteness of a lesion. Of course, any movement of the flexor carpi ulnaris or adductor of the thumb which is not supplementary in character determines an incomplete lesion. Of 16 partial or recovering lesions, 12 showed motor phenomena indicative of the severity of the lesion. In 9 severe cases not due to anatomical section, the motor phenomena were suggestive of partial lesion in 5 but conclusive in none.

Of 16 cases of recognized partial or recovering lesions, 11 showed incomplete sensory loss. Sensation was completely lost in all severe partial lesions. Where sensory regeneration had occurred, usually motor recovery could likewise be demonstrated.

b. *Median nerve lesions.* Physiological interruption cannot be differentiated from anatomical section by the strength of the movements of the phalanges of the fingers. Although in a considerable number of cases the movements of the index finger were stronger, this could not alone determine the character of the lesion. Return of function in the opponens pollicis would indicate a partial or recovering lesion but because of supplementary motility is very difficult to determine. I wish to call attention to a supplementary movement producing abduction of the thumb at right angles to the palm which I have not before noted. When the metacarpophalangeal joint of the thumb is partially ankylosed, so that no flexion or extension in the plane of the palm is possible, contraction of the extensor longus pollicis and the extensor ossis metacarpi pollicis produces abduction of the thumb as above described.

Sensory regeneration or incomplete sensory loss in the area supplied by the median nerve is almost constant in complete lesions and in otherwise physiologically complete ones; i.e., sufficiently severe partial lesions to come to operation. In a large proportion of partial or recovering lesions sensory regeneration is present when motor phenomena give no indication of regeneration.

c. *Ulnar and median lesions.* When observed sometime after injury (more than 5 months), it would appear that anatomical section of both ulnar and median nerves produces complete paralysis of all the phalanges of the fingers and thumb; and severe lesions, not anatomical sections, show some movement in some of the phalanges of all of the fingers.

In incomplete lesions of either ulnar or median nerves, weak movements of the phalanges of the fingers, if interpreted alone, are insufficient guides as to whether one of these nerves is severed and as to which one may be severed.

As in isolated lesions of the median nerve, so when combined with an ulnar nerve lesion, it was seen that in partial or recovering lesions and in more than half of the severe lesions, not anatomical sections, incomplete sensory loss in the median distribution was present.

Only a few of the cases of incomplete ulnar and median nerve lesions showed incomplete sensory loss in the ulnar distribution, and in only 1 of 17 cases was this the case when phenomena of motor regeneration were inconclusive. Only one severe incomplete lesion showed incomplete sensory loss of the ulnar. In complete lesions of the ulnar and incomplete of the median when sensory regeneration was demonstrable, motor regeneration was likewise present.

It is emphasized that recovering or incomplete lesions of the median nerve may almost regularly be determined by sensory examination, whereas in ulnar lesions this rule does not apply, contrary to the generally accepted statement that signs of sensory regeneration are first to appear.

THE SURGICAL TREATMENT OF LATERAL CERVICAL FISTULÆ[1]

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LATERAL cervical fistulæ, frequently incorrectly termed "branchial fistulæ," are congenital fistulæ, the internal openings of which are in the pharynx and the external openings of which are in the skin of the neck, generally in the region of the lower portion of the sternomastoid muscle. In addition to these complete fistulæ, there are also incomplete internal fistulæ which open internally only and incomplete external fistulæ which open externally only. Median cervical fistulæ form a separate class of fistulæ and are not taken up in this paper.

In the last 100 years, congenital cervical fistulæ and cysts have afforded a favorite subject of contributions to surgical and pathological literature. Over 400 authors have added the results of their researches and experiences, so that at present the knowledge of this subject is very complete. There has been a tendency, however, of many recent authors to overlook the work of other contributors in this field, and to be unconscious of the necessity for discarding old conceptions.

Probably the first reported cases were the two by Huncyowski in 1789 (23). In 1829 Dzondi (13) described four cases of "fistulæ trachæ congenitæ," because he erroneously thought that the internal opening of these fistulæ was in the trachea. In 1832, Acherson (1) published his "De Fistulis Colli Congenitis," and in this paper contributed two important ideas. First, he distinguished between median and lateral fistulæ, and, second, he was the first one to associate lateral cervical fistulæ with incomplete closure of the branchial clefts. The creation of the term "branchial fistula," however, remained to be the work of Heusing (21) in 1864.

In the human being (20) it has been formerly taught that the pharyngeal cavity is bounded in early fetal life by four plates on each side, each pair of plates constituting a branchial arch, of which there are consequently four; they are, in other words, columns of tissue separating adjacent clefts from one another. The branchial clefts have been said to unite during early fetal life, with the exception of the first one, from which is formed the Eustachian tube, the cavity of the tympanum, and the external auditory canal—a fistula but for the tympanic membrane. From the second branchial arch comes the styloid process, the stylohyoid ligament, and the lesser horn of the hyoid bone; the body and greater horns of the hyoid are formed out of the third arch, while the fourth aids in forming the soft tissues of the neck. The glands, trachea, and larynx are formed from other growth centers.

Repeated observations and embryological contributions served to strengthen the hypothesis that lateral fistulæ and cysts resulted from the incomplete closure of a branchial cleft, until this hypothesis came to be accepted as a truth. The second branchial cleft was thought to be the one most commonly concerned in these fistulæ, although the first (16) has been mentioned.

In 1912 Wenglowski (35) published the most important single contribution on the etiology of lateral cervical fistulæ. His work has compelled us to forsake completely the branchiogenic theory of origin. Wenglowski's paper was the result of five years of intensive work. He collected and studied (in his investigation of both median and lateral cervical fistulæ) 78 embryos ranging in length from 2 millimeters to 49 millimeters. Serial sections were made of these and from the sections, wax plates which, in turn, when built up, made large wax models. He also made serial sections of 147 child cadavers and 59 adult cadavers. Moreover he studied 21 cases of actual neck fistulæ or cysts.

His conclusions are of such interest and importance that they are given herewith in full:

1. In man there develop five to six branchial arches and the same number of clefts or grooves. *The grooves are not open.*[2]

[2] Italics are author's.

[1] Read before the Evanston Branch of the Chicago Medical Society, October 25, 1923.

2. The neck sinus—sinus cervicalis—is built by the approximation of the lateral borders of the neck, breast, and the under border of the third arch and not the second as His contended.

3. In embryos as well as in adults the branchial apparatus does not lie from above downward but from front to back. Its inferior border and the inferior border of that part which arises from it, is made by the line which passes through the inferior border of the hyoid bone.

4. In the beginning of the second month, the entire branchial apparatus as such disappears. It may leave behind it portions of many-layered epithelium, or even particles of cartilage lying freely in the tissue. All the vestiges are usually found above and dorsal to the hyoid. *The branchial apparatus cannot leave remnants in the neck below the hyoid.*[1]

5. The thymus originates from the third pharyngeal pouch in the form of a *long canal running obliquely from the lateral pharyngeal wall to the sternum*[1] where the characteristic thymus substance begins to develop.

6. The thymic duct usually disappears either partly or entirely. Occasionally, the entire duct or one of its parts (more frequently the lower) may persist.

7. *The vestiges of the thymic duct may change into a lateral cervical fistula or cyst.*[1] If the entire thymic duct persists a complete fistula will result; when only a part of it, an incomplete.

8. The anatomical situation of the lateral fistulæ corresponds very closely with the course of the thymic duct. The walls of the lateral fistulæ are generally covered with squamous epithelium, but ciliated epithelium is occasionally found.

9. *The lateral thyroid lobes also have a short canal which disappears early. By analogy with the thymic duct one can consider that this canal may also persist and form fistulæ and cysts.*[1] The inner opening of such fistulæ is found lateral to the entrance of the larynx.

Heredity has been thought by many observers to play an important part in the etiology. Vaughn[1] (34) reports a case of unusual interest in this connection. His patient was a young woman with a bilateral fistula. Her grandmother had one fistula on the right side of the neck. Her sister had one fistula on the left side, and a daughter one fistula on the left. The anomaly is said to be more frequent in females than in males and may first be perceived as late as at 19 to 20 years of age. Lateral cervical fistulæ are much more rare than median (4).

The skin opening of a lateral cervical fistula is on the front of the neck, and is usually pin point in size. It is generally between the midline and the sternomastoid muscle and between the hyoid bone of the sternal notch, but rarely ever below the clavicle.

The tract then passes upward and inward where it may come in close relationship with the carotid sheath and jugular vein. It crosses the carotid bifurcation and passes beneath the digastric muscle. It is near to the hypoglossal and glossopharyngeal nerves and enters the lower pharynx or posterior palatine arch near the tonsil.

The fistulæ may be so large that crumbs of bread, etc., can pass through (15). Lesser (30) reported an interesting case in which the patient could pass a bent needle from inside the pharynx to the outer opening just above the sternoclavicular articulation and draw it out. The sound could be passed only 8 centimeters into the outer opening.

The fistulæ are lined with epithelium, part of which is cylindrical and the other part squamous. Outside of the epithelium is a connective tissue layer and occasionally mucous glands and cross-striped muscle are found. Leegard believes the endoderm plays the principal rôle in the origin of the fistulæ.

In order to determine whether an external fistulous opening communicates with the pharynx, butter or other fluids which may be tasted (22) have been injected.

The injection of the fistula with barium and subsequently X-raying it, was mentioned by Dowd (10) in 1916. Gilman (17) shows an excellent roentgenogram illustrating this diagnostic procedure to which Leriche and Badoll (29) have given the term "Fistulographie."

[1] Italics are author's.

Leegard (27) says that the right side is more frequently the side of lateral fistulæ than the left, and believes the fact to be probably explained in the normal embryological development.

The rising of the fistula with deglutition is said to signify that the fistula is a complete one.

Related to lateral cervical fistulæ are three groups of congenital anomalies, (a) congenital ear fistulæ, (b) auricular appendages, (c) congenital skin growths on the side of the neck.

The patients generally come for treatment because of the annoyance of a periodical purulent discharge on the skin of the neck. Perhaps a more important reason for dealing with them is that they undoubtedly constitute foci of septic absorption and are a detriment to the general health. Eddower (14) reports the case of a nurse aged 30 who had an occasional regurgitation into her mouth of matter "like the discharge from a gum boil," and remarks that "it was obvious that the patient, whose physique was otherwise good, was having her health ruined by the filthy pouch," and he accordingly referred her to a surgeon.

Karewski (24) called attention to the difficulty of the surgical care of a carcinoma developing out of such a fistula.

Although one case of alleged spontaneous healing of a fistula has been reported, it may safely be said that they never heal.

Many methods of treatment of lateral cervical fistulæ have been tried. The earlier observers avoided surgical intervention because of the proximity and even adherence of the tract to the important structures of the neck. One writer Chalot (7) even held total extirpation to be impossible. Guth (18) reported the case of a soldier discharged from the army because of a lateral cervical fistula and said that an attempt to dissect out the fistula would have been "folly" because of its length and proximity to the vessels and nerves.

Numerous substances were employed for injection into the fistulæ. Iodine, alcohol, and trichloracetic acid have been used. In Dzondi's (12) case which was injected with mercuric nitrate, the termination was fatal. Chevers (8) reports a case apparently cured by injection of croton oil. The incomplete fistulæ lend themselves better than the complete to cure by injection.

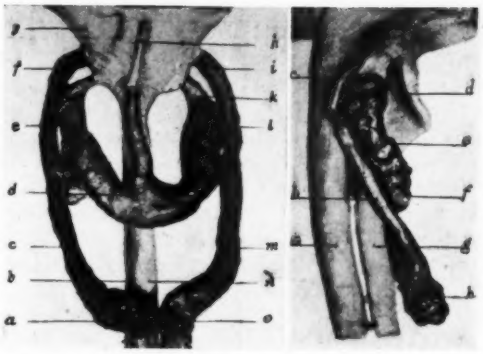

Fig. 1 (at left). Model of the pharynx, trachea, and the organs which develop from them in a 14 millimeter embryo. *a*, thymus; *b*, œsophagus; *c*, duct of the thymus; *e*, lateral lobes of the thyroid; *f*, duct of the thymus; *g*, pharynx; *h*, thyrolingual tract; *i*, duct of the thymus; *k*, duct of lateral lobes of thyroid; *l*, lateral lobes of thyroid; *m*, duct of the thymus; *n*, trachea; *o*, thymus. (Wenglowski.)

Fig. 2. Model of the pharynx, œsophagus, trachea, and the organs which develop from them in a 20 millimeter embryo, lateral view. *a*, Œsophagus; *b*, duct of the thymus; *c*, remains of the upper part of the duct of the thymus; *d*, larynx; *e*, lateral thyroid lobes; *f*, median thyroid lobes; *g*, trachea; *h*, thymus. (Wenglowski.)

Electrolytic treatment was used as early as 1885 by L. Lefort (28), and Lichtwitz (31) reported a case cured by this method.

As early as 1893 Karewski (24) stated that radical extirpation was the only sure cure and at the present time this represents the consensus of opinion of surgeons (25).

Various surgical procedures have been employed in the excision of lateral cervical fistulæ and a consideration of them impresses one that each has its merits according to the obstacles encountered. No one operation can be recommended to the exclusion of others.

As the tract is very thin walled and difficult to distinguish from adjacent structures some method must be adopted of identifying it during the dissection. The best method is to inject the fistula with methylene blue until the coloring matter appears in the pharynx (in the case of the complete fistulæ). A blunt hypodermic needle is useful for the injecting.

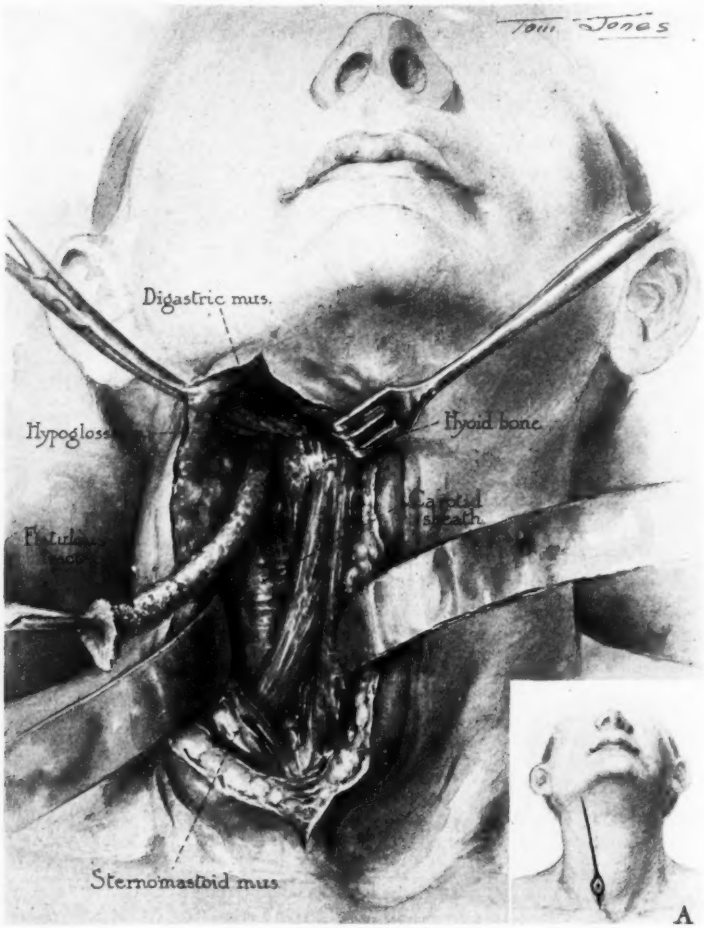

Fig. 3. Shows excision of fistulous tract and its relations. Clamp on end of fistula should be shown as closing the tract to prevent escape of fistula contents instead of as it is. Insert shows location of opening of tract and line of incision.

Dowd (10) has passed a ureteral catheter into the fistula and dissected down on this for a guide. In incomplete fistulæ S. W. McArthur (32) has injected molten paraffin which when hardened made a good method of locating the tract.

A single vertical or slightly oblique incision, 8 to 10 centimeters in length, immediately over the fistulous tract is probably the incision of choice. Broca (3) used two separate small incisions following the tract from one to the other under the skin. J. Douglas (9) reported a case dissected out through two small incisions.

Throughout the operation it is necessary to consider the inside of fistula unsterile and to avoid contaminating the wound with any of the contents of the tract. With this end in view it is best to start the incision with a small circular cut around the fistulous opening and close the latter at once with a hæmostat. Traction is now put upon the tract

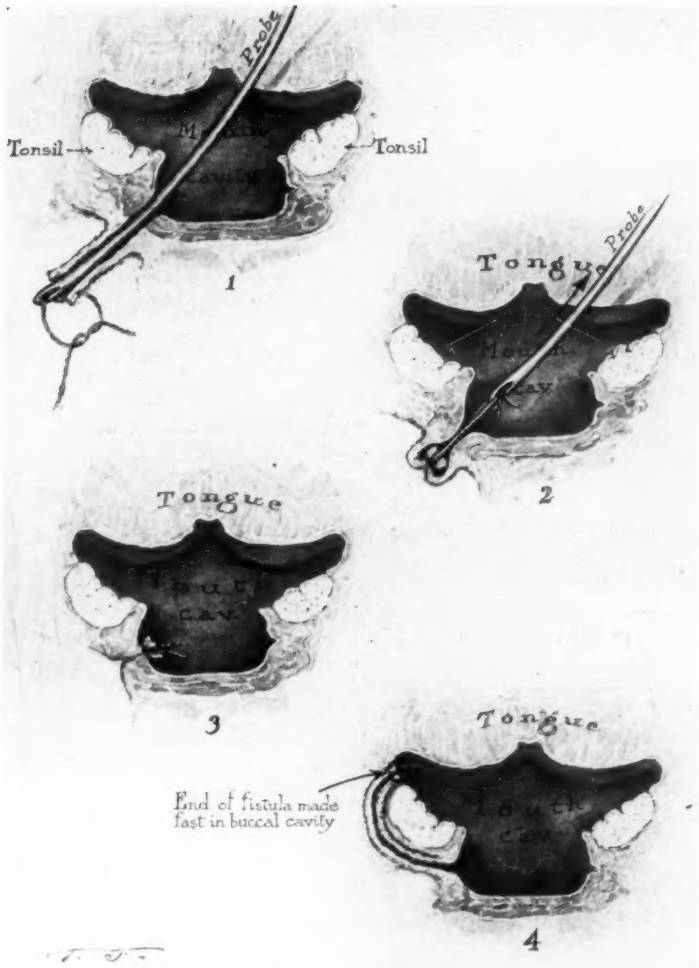

Fig. 4. Diagram showing steps in the von Hacker and Koenig operation shown in cross section at level of tonsil. *1*. The dissected fistulous tract has been amputated and the stump has been made fast to the eye of the probe. *2*. Probe drawn into mouth and fistula being inverted. *3*. Tract has been entirely inverted, ligated, and cut off. *4*. Procedure in the Koenig operation. The stump of the tract has been brought anterior to the tonsil and passed into the buccal cavity where it has been made fast.

and it is carefully dissected free from the adjacent structures. Blunt dissection is the method of choice and a cut should only be made after careful identification of the tissues to be severed. The ingenious fistula clamp of Balkhausen (2) may be of use though mention is not made of its being so used.

During operation the tract may become a mere fibrous cord as in Cadet-Boise's (5) case. It may be necessary to resect part of the hyoid bone (25). Small portions of bone or cartilage may be found in the tract (11).

If possible the dissection should be carried on under the posterior belly of the digastric

Fig. 5. (Patient M. C.) Showing situation of scar which has a slight tendency to keloid formation.

muscle, taking care to avoid the hypoglossal nerve, and be extended to the pharyngeal wall (Fig. 3). At this juncture the freed tract should be divided between clamps about 2 centimeters distal to the internal orifice and the proximal cut end cauterized.

The manœuvre which constitutes the essential feature of the von Hacker (19) operation should now be employed. The proximal cut and cauterized end of the fistula is cautiously opened so as not to spill fistula contents in the wound. A probe, bearing a piece of ligature threaded through its eye, is now passed through the fistula into the mouth. The ends of the ligature are made fast to the cut end of the fistula by transfixion (Fig. 4, *1*). The probe is now drawn out through the mouth and gentle steady traction made upon the ligature. This causes the fistula to become inverted as a glove finger is turned into itself (Fig. 4, *2*) and the inverted end is finally drawn into the pharyngeal cavity. Here the fistula is ligated and cut off short, leaving, protruding into the pharynx, a short stump (Fig. 4, *3*), which soon sloughs and atrophies to the normal level of the pharyngeal mucous membrane.

The above method is decidedly the method of choice. Occasionally, however, it is impossible to invert the fistula even though it has been entirely mobilized. In this event, its pharyngeal orifice is excised with a small portion of the adjacent mucous membrane and the latter is closed with a purse string.

In many cases it is found that after the tract has been freed part way, it is so adherent, as the result of previous inflammation, that it is impossible to dissect it out entirely. If this be the case, the Koenig operation (26) should be used. In this procedure the freed distal end is passed through the mucous membrane of the mouth in front of the tonsil and is sutured there. This transforms the pharyngeal-cutaneous fistula into a curved sinus having a pharyngeal opening at one end and a buccal at the other (Fig. 4, *4*), and all external discharge is done away with.

Cates (6) reports an interesting case of a lateral cervical cyst which was adherent to the carotid sheath. After the surgical removal the pupil on the affected side remained dilated after operation for a long time and interfered with vision.

The following is the report of a case operated upon by the von Hacker method:

Patient, Marian C., age 7, was admitted to the Evanston Hospital on May 9, 1923, with a diagnosis of lateral cervical fistula. When the patient was 3 weeks of age, the mother noticed a small opening on the right side of the neck. At this time there was no discharge. When the patient was 3 years of age the mother began to notice a serous discharge on the child's dresses but never noticed the discharge on the neck itself. Since February, 1923, the discharge has become profuse and purulent, and the patient has been noticed to be clearing her throat frequently. The past history was negative except for a few sore throats, scarlet fever, measles, and mumps.

The physical examination was entirely negative save for the neck. There is an opening in the skin of the neck about 2 millimeters in diameter and situated about 1.75 centimeters to the right of the midline and about half-way between the hyoid cartilage and the suprasternal notch. On deglutition the tract communicating with the skin opening became tense and was seen to extend upward and posteriorly into the tissues of the neck. No attempt was made either to probe this tract or to inject bitter substances. The urine was negative. Nose and throat cultures were negative.

On May 10, 1923, the patient was operated on (Dr. Christopher), nitrous oxide and ether anæsthetic being used. The fistula was injected with methylene blue and this promptly appeared in the nasopharynx demonstrating the fistula to be a complete one.

A vertical incision was extended upward from the orifice of the fistula and the tract carefully dissected free from the adjacent structures after the manner described above. After the tract had been mobilized it was severed some 2 centimeters from the pharyngeal end. A probe was now passed through the fistula into the nasopharynx, but not without some difficulty, and the tract was inverted as in the von Hacker method, ligated, and cut off (Figs. 1 and 2).

The wound was closed without drainage and healed rapidly save for a small amount of superficial infection which quickly subsided. The pathologist (Dr. J. L. Williams) reported the sinus to be lined with chronic granulation tissue and as having a considerable amount of lymphoid tissue in its wall. In places there is a layer of mucous membrane covering the lymphoid tissue which resembles in some respects the mucosa of the large bowel.

The patient was discharged from the hospital on the third day postoperative and came to the office for a few dressings afterward. When last heard from in June, 1923, the patient was in excellent health and the wound entirely healed.

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MALIGNANT TUMORS OF THE PAROTID GLAND WITH ANALYSIS OF A CASE

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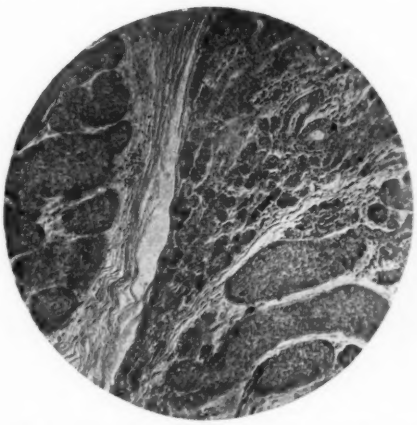
THE nature and origin of malignant epithelial tumors of the salivary glands is a subject which shares the uncertainty still surrounding the histogenesis of the so-called mixed tumors. Through the studies of Krompecher and more recently of Masson and Peyron it has been satisfactorily established that the mixed tumors are epithelial in nature, and the older view of endothelial origin fostered by Volkmann with the support of a large number of German writers and more recently resurrected by Martini is generally considered untenable. It has been shown by the above authors that the mucoid and cartilagenous areas in the mixed tumors are derived from the epithelial element by unusual metaplasia.

There is still uncertainty regarding the origin of the epithelial cells giving rise to the mixed tumors, and as Ewing states it appears that "no single source of the mixed tumor meets all the requirements." They have been considered by Hinsberg, Chevassu, Wood, and others to arise from branchial remnants, this origin being suggested by the presence of cartilage and bone and by the complete isolation from the gland with definite encapsulation which may be present. The cytological studies of epithelial metaplasia by Masson and Peyron make it unnecessary to invoke this origin to explain the cartilage and bone. Forgue and Roux hold to the theory of embryonic origin and believe the tumors to be true teratomata not entirely of epithelial origin. An origin from the adult epithelium of the salivary glands is described by Pérochaud and other French writers, while Wilson and Willis and others believe that there is considerable evidence to support the theory that the tumors are mesotheliomata having origin in embryonic glandular rests. From evidence obtained in a combined experimental and pathological study, Fraser would assign their origin to glandular ducts.

The usual course of a mixed tumor is one of relative benignity but instances of a change from a slowly growing tumor of many years' duration to a malignant growth are not infrequent. The case reports of Nasse and Hinsberg suggest such an occurrence, and Landsteiner reports a case of rapid growth occurring in a tumor of 16 years' duration in which he was able to demonstrate cartilage in the "old part" and squamous cell carcinoma in the infiltrating part. Since this time there have been several case reports of malignant mixed tumors but little is known of their histology. The portion which becomes invasive is usually more cell rich and poor in connective-tissue stroma than the original tumor. Although the malignant change may be sarcomatous as described by Wood, most cases are epithelial and appear clinically as carcinomata. The tumor may take the form of strands of round or polygonal cells (Brandes, Briddon), or may show alveolar structure as the case LeDentu described as an alveolar sarcoma. The epithelial growth in Landsteiner's case was of squamous cell type, and Ehrich reports a tumor showing squamous cells in one place and cylindrical epithelium in another, both of cancerous nature.

Metastases of malignant mixed tumors take place through the blood stream rather than to the regional lymph nodes. Of 8 cases from the literature which are quite clearly of mixed tumor origin, and in which metastases are described, 6 showed blood borne metastases (Budde, Chiari, Foerster, LeClerc, LeDentu and Payne) while only 2 showed involvement of cervical lymph nodes (Brandes and Wood). The interesting case of Griffini and Trombetta showed both glandular and pulmonary metastases. The histology of the metastases is seldom given in the case reports but is usually similar to that of the malignant portion of the primary tumor (Heineke) and is of carcinomatous structure. The metastases in the case of Griffini and Trombetta were cartilaginous, but as pointed out by Wood may have been direct extensions of the primary growth.



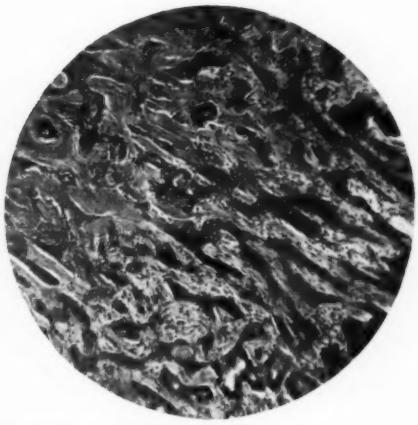


Fig. 1 (at left). Tumor cells in close proximity to normal parotid acini. Cancer.
Fig. 2. Small epithelial cells in mazy plexiform lines with hyaline degeneration and atrophy of cell columns. Cylindroma.

A large number of salivary gland tumors have been described under the term cylindroma. The peculiar structure designated is an arrangement of small darkly staining polyhedral cells in plexiform strands or broad sheets with the enclosure of small areas filled with mucus. Hyaline degeneration is frequently seen in the connective-tissue stroma. These characteristics are suggestive of basal cell carcinomata or adenoid cystic epitheliomata. The origin and nature of cylindromata was for years the subject of active controversy especially among German writers. Loewenbach first definitely emphasized their carcinomatous nature and describes two cases of submaxillary cylindromata the origin of one of which is traced to the ducts and the other to the acini of the gland.

Recently Heineke in an excellent review of the subject considers that they are varieties of mixed tumors and calls attention to the many types of intergrades that are described. Fraser believes that the process of hyaline deposition in cylindromata is closely allied to the myxomatous and cartilaginoid changes in mixed tumors. Ewing describes them simply as adenocarcinomata and does not attempt to differentiate what he considers to be a primary adenocarcinoma growing with basal cell metaplasia from a basal cell type of mixed tumor which does not show myxomatous or cartilaginous differentiation. Clinically the cylindromata closely resemble the mixed tumors in encapsulation, extraglandular location, and in a relatively benign, slowly growing stage which may terminate in malignant activity, with metastases (Tomassi, Barozzi and Lesné). The typical history is of a small tumor mass which has been present for several years or since childhood, which suddenly begins to grow more rapidly and invades the surrounding tissues. The first operation is frequently inadequate and is soon followed by recurrence. The early recognition of this type of growth and its proper radical treatment is urged by Brandes and by Adson. Both advise complete removal of the gland, if there is reason to believe that the growth has extended through its capsule, and Adson and Ott describe a method of excision of the parotid with preservation of the facial nerve.

There are relatively few case reports of primary carcinomata of the salivary glands which can be clearly distinguished from carcinomata arising in mixed tumors. Of 267 tumors of the salivary glands reported by six authors (Wood, Nasse, Volkmann, Landsteiner, Kaufmann and Kuettner) 13, or 4.8 per cent were carcinomata. This percentage may be considered as only roughly approximate, as many of the reported cases have but fragmentary clinical histories to

Fig. 3. Roentgenogram showing homogeneous density in lower two-thirds of left chest with obliteration of diaphragmatic shadow and costophrenic angle. Condition was thought to be a pneumonic process.

correlate with the confused pathological terminology. Other cases have been reported by Nasse, Tilton, Ehrich, Speese, Fraser, and Payne. Histological proof of the origin of the tumor from the acini of the gland is difficult and, although in a case reported as adenocarcinoma, Doerr shows tumor lobules lying adjacent to normal glandular substance, Brandes remarks that to furnish certain proof the tumor cells must lie in the same acinus with normal cells. The tumors usually reproduce the acinar structure of the gland and may produce a mucoid secretion. There are commonly two types described, the scirrhous and medullary, although Heineke believes most of the tumors described as medullary are malignant mixed tumors. The growth is usually very hard and fused with the gland, and the cervical lymph nodes are invaded early. In further contrast to the malignant mixed tumors there are rarely metastases to internal organs. Delanglade attaches diagnostic importance to early facial paralysis. Pain is a frequent symptom.

CASE HISTORY

The case presented is that of an adenocarcinoma of the parotid region in which during the course of numerous recurrences, the preponderance of cells which had undergone differentiation to the basal cell and hair matrix type caused confusion regarding the proper classification of the tumor, and led ultimately to a lack of appreciation of the fundamentally malignant nature until it demonstrated itself by general metastases.

Mrs. H. L., a widow, age 32, came to the Out-Patient Department of the Massachusetts General Hospital on December 30, 1908, for a swelling of a year's duration in front of the right ear. The lesion was described in the record as a "discrete gland" and a note was made of partial right facial paralysis. The patient did not return until 5 months later when she was referred to the surgical service.

May 28, 1909. The family history was negative for tuberculosis or cancer. The past history included a left salpingo-oophorectomy with routine appendectomy for chronic salpingitis in 1904. The tumor in front of the right ear for which she entered was the size of a pigeon's egg, of firm elastic consistency, and fixed to the underlying tissues. It was said to have varied somewhat in size during the past year, but recently had grown steadily larger, and although at first it was freely movable, it had been fixed for at least 8 months. At times it caused pain which was referred to the neck. There was absence of wrinkles on the right side of the forehead.

Operation. June 3, 1909. Dr. F. G. Balch. The tumor was found to lie superficial to the parotid gland and was removed entire in its capsule.

Pathological report. An oval infiltrated growth 4 by 2 centimeters with opaque, slightly fibrous surface. Microscopical examination showed solid masses of epithelial cells infiltrating the tissue in all directions. Cancer. (Dr. W. Whitney.)

October 28, 1909. Five weeks after the operation the pain recommenced and gradually became more severe. Shortly afterward the patient noted a swelling in the region of the scar which varied somewhat in size but gradually became larger.

In front of the right ear there was a surgical scar 1½ inches long above a hard, nodular, slightly movable plaque extending from the top of the ear to the angle of the jaw, and forward 1½ inches from the ear. There was distinct limitation of motion of the jaw bone but no adjacent glandular hypertrophy was noticeable.

Operation. November 8, 1909. Dr. C. A. Porter. Dissection was carried down to the great vessels of the neck. The glands were removed, and the submaxillary triangle was cleaned out. The space behind the angle of the jaw was cleaned as far as the mastoid process and up to the foramen ovale. The skin was incised close to the ear in front and

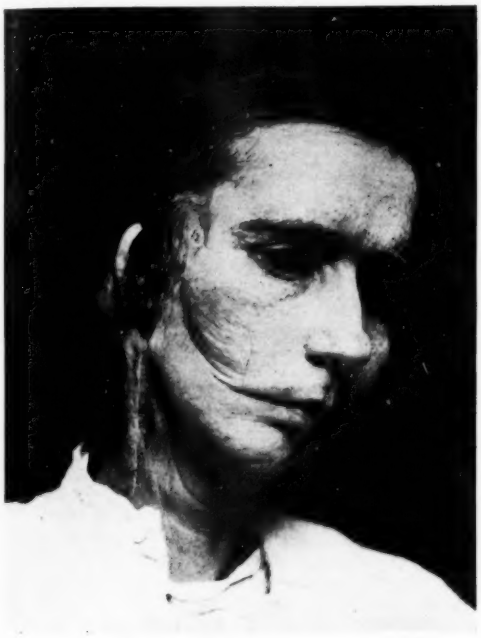


Fig. 4. Locus of tumor free from recurrence, with scar.

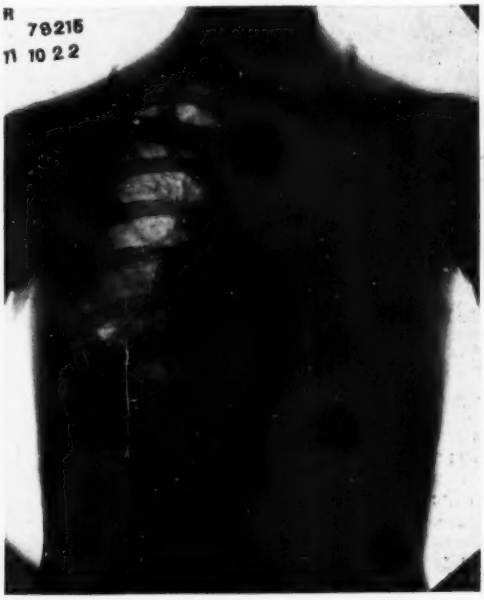


Fig. 5. Roentgenogram showing dullness throughout the entire left chest including the apex.

the tumor mass was removed. Stenson's duct was ligated. The carcinoma had extended so close to the jaw that further growth seemed almost certain.

Pathological report. (Fig. 1.) A mass of new-growth 5 centimeters in diameter showing upon microscopical examination solid masses of large epithelial cells were evidently springing from the acini of the gland and infiltrating the tissue irregularly. Cancer. (Dr. W. Whitney.)

On November 13 the patient was given her first treatment with X-rays. Facial paralysis was complete following the operation.

The clinical course and pathological findings at this time indicate that the tumor was an adenocarcinoma arising either from the acinar epithelium of the parotid gland, or from malignant change in an extraglandular mixed tumor. The original operative note which describes an encapsulated growth is suggestive of a tumor of extraglandular origin of the form frequently assumed by the so-called mixed tumor. The pathological description of the tumor removed at the second operation indicates an acinar origin for the cancer cells, this conclusion apparently being based on the proximity of tumor cells to normal parotid acini as is shown in Figure 1. This same finding is reported by Doerr and also by Brandes. The latter, however, as was stated above, believes that to prove their origin from parotid tissue, the tumor cells should be demonstrated to exist in the same acinus with normal cells and not merely in adjacent lobules. The spontaneous facial paralysis and pain suggest a primary parotid growth, as does the relatively short duration of tumor, and its pure glandular structure.

April 22, 1912. A year ago the patient noticed a swelling over the zygoma which has since increased in size. There is not much pain, but constant tenderness. The tumor is small, firm, immovable, and slightly tender.

Operation. April 24, 1912. Dr. C. A. Porter. The tumor was found to involve the posterior portion of the zygoma and upper part of the ramus of the lower jaw, extending down to the fascia of the temporal muscle but apparently not involving the skull. The tumor was excised with the posterior portion of the zygoma, the upper part of the ramus of the lower jaw including the entire joint, a small part of the superior maxilla and the fascia of the temporal muscle.

Pathological report. (Fig. 2.) A hard tumor mass the size of a hen's egg with smooth white section surface from the parotid, on microscopical examination showed a mass of rather small epithelial cells in mazy plexiform lines in places with hyaline degeneration about them and with considerable atrophy of the cell columns. Cancer. (Cylindroma.) (Dr. W. Whitney.)

At this time, 3 years after the original operation, we find noted the appearance of basal cell metaplasia

and the tumor is classified as a cylindroma although its malignant nature was keenly appreciated.

May 21, 1914. About 1 month ago the patient noted a small lump growing on the right ear which is now seen as a firm cherry sized tumor involving the tragus.

Operation. May 23, 1914. Dr. C. A. Porter. The tumor was excised by a circular incision which passed across the auditory canal.

Pathological report. Microscopical examination showed a lobulated growth of solid masses of epithelial cells in arrangement recalling that of a gland and separated by distinct bands of fibrous tissue. Sebaceous adenoma. (Dr. W. Whitney.)

July 22, 1914. A small Thiersch graft from the thigh was placed to cover the defect of the previous operation.

Although the glandular structure was still noted, the basal cell differentiation was so complete at this time that the diagnosis of sebaceous adenoma is accorded this recurrence. From this time the true nature of the tumor gradually became obscured.

August 17, 1915. Lately a small lump appeared in the right temporal region which is now seen as a small, hard nodule in the upper anterior portion of the scar.

Operation. August 18, 1915. Dr. R. B. Greenough. Excision and cauterization of an epithelioma of the right temporal region.

Pathological report. Microscopic examination showed columns and groups of atypical epithelial cells in a stroma of connective tissue. The cells resembled the epithelial cells of the hair roots or cells of the basal layers of the epidermis. The tissue shows considerable necrosis. Carcinoma of basal cell type. (Dr. J. H. Wright.)

July 8, 1916. About 1 month ago the patient noticed a small lump in front of the right ear which was now the size of a small bean.

Operation. July 9, 1916. Dr. C. A. Porter excised an epidermoid carcinoma of the face with Thiersch graft to the defect.

Pathological report. A button shaped tumor the size of a cherry stone having a gray-white section surface on microscopic examination showed irregular masses of undifferentiated cells infiltrating the corium and covered with a stratified epithelium which showed the underlying papillary processes flattened out. Here and there were areas of round cell infiltration. This type of carcinoma is derived from the cells of the hair follicles. Epidermoid carcinoma. (Dr. H. F. Hartwell.)

The typical story of a small recurrent nodule near the ear was repeated five more times and once the patient entered for removal of a sequestrum of the temporal bone. Excisions of the nodules were performed by Dr. C. A. Porter. Pathological reports were as of July 8, 1916. Epidermoid carcinoma.

During these 6 years the tumor was classified both pathologically and clinically as an epidermoid carcinoma. Traces of the original acinar structure were obscured by the basal cell differentiation, and the local recurrences were typical of a tenacious epithelioma. The tumor as judged at this time might have been either a mixed tumor of adenoid cystic epithelioma type, a primary cutaneous epithelioma arising in the operative scar, or as really was the case an adenocarcinoma arising either primarily in the gland or in a mixed tumor.

September 19, 1921. After leaving the hospital 2 years ago the patient was well for 7 months when she had an attack of pneumonia lasting 6 weeks. A year later she had a second attack of pneumonia of 6 weeks' duration. She has not felt well since this last sickness and has lost 13 pounds; has had recurrent "colds" since May, 1921, with a small amount of blood tinged sputum. Pain in right scapular region was intensified by her "colds." Three months ago she noted a small lump back of the right ear which has grown somewhat larger.

The right parotid region shows thin white skin closely applied to the bones of the skull owing to absence of underlying tissues. The ear is involved in the cicatrix, and is fenestrated posteriorly. Just beneath the ear is a small, hard freely movable mass the size of a pea. There is a complete right facial paralysis and numbness of the right side of the face throughout the distribution of the lower two divisions of the trigeminal nerve.

The chest examination showed dullness throughout the left chest posteriorly, more marked at the base. Breath sounds, tactile fremitus and voice sounds were diminished over this area. No râles were present. A medical consultant believed these signs to indicate thick pleura only and attributed the hæmoptysis and colds to pharyngeal infection.

Operation. September 29, 1921. Dr. C. A. Porter. The lobe of the ear was excised with the nodule. The surface of the mastoid bone was removed with chisel and actual cautery.

Pathological report. Microscopical examination of the larger nodule from the ear showed solid clusters and strands of undifferentiated epithelial cells with reactionary fibrosis. No cornified or prickle cells could be found. Mitotic figures were numerous. A section of the nodule from the mastoid region showed a similar tumor invasion. The appearances resembled carcinoma arising from hair roots. (Dr. H. F. Hartwell.)

During her convalescence she experienced an exacerbation of pulmonary symptoms and was considered to have a "pneumonic focus" in the left lower lobe. An X-ray taken at this time (Fig. 3) showed homogeneous density in lower two-thirds of left chest with obliteration of diaphragmatic shadow and costophrenic angle. The condition was thought to be a pneumonic process in the lung.

She was referred to the Huntington Hospital where radium seeds were implanted in the operative field.

In looking back at this entry one can clearly see pictured the onset of metastatic malignant disease of the lung. The nature of the process at this time was not recognized, as the signs and symptoms,

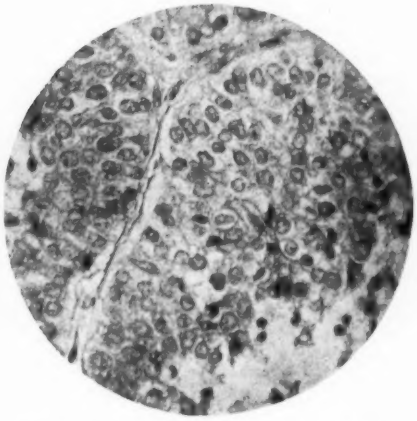


Fig. 6 (at left). Large, degenerate, atypical cells in a fine vascular stroma; metastatic carcinoma.
Fig. 7. Columns of atypical epithelial cells invading the muscles and nerve sheaths, with areas of gland tubule formation. Numerous mitotic figures.

except perhaps the hæmoptysis, were consistent with the two preceding attacks of pneumonia, and the tumor had now for several years been passing for a simple basal cell carcinoma of hair matrix type which practically never shows pulmonary metastasis.

November 2, 1922. The patient has continued to have intermittent "colds" with cough and blood tinged sputum. One week ago she began to experience severe pain in the left chest at the base of the lung. She has grown increasingly weak and has lost considerable weight.

Physical examination showed locus of tumor free from recurrence with scar as described September 19, 1921 (Fig. 4). The left chest scarcely moves on respiration, and is flat to percussion throughout with absent breath sounds, vocal and tactile fremitus except at the extreme apex. The fingers are somewhat clubbed.

The sputum was small in amount, bloody, mucoid, and contained no tubercle bacilli.

X-ray examination (Fig. 5) showed dullness throughout the entire left chest including the apex. The dullness is of even density throughout and in the prone position the heart and mediastinal contents were displaced to the right. In the erect posture there was little or no displacement of the mediastinum. The shadow of the ribs can be seen, but the outline of the diaphragm is obliterated. There is no evidence of pathology in the right chest. The appearance could be due to extensive malignant disease, or to a very large amount of fluid. (Metastatic malignant disease of lung.)

A medical consultant considered that the condition in the left chest was probably extensive pleural thickening dating to the pneumonia 3 years previously. The left apex was thought to show either atelectasis from compression or old fibrosis, or new-growth. The cardiac displacement was not great.

The white count varied from 15,200 to 28,00 with 85 per cent polymorphonuclear neutrophiles The blood Wassermann was negative.

A chest tap was done on November 2 in the eighth interspace midscapular line. The needle met solid resistance and a small amount of blood and bloody fluid was obtained. No organisms were found in smear or culture. A few shreds of tissue were sent to the pathological laboratory.

Pathological report. (Fig. 6.) A small soft fragment removed at a pleural tap, showed on microscopic examination sheets of large degenerate, atypical cells in a fine vascular stroma. Metastatic carcinoma. (Dr. H. F. Hartwell.)

Although the diagnosis made by pleural tap was in all probability trustworthy, there were many features about the case which led one to believe that the condition might be a chronic suppurative pleurisy. The irregular temperature, leucocytosis, history of previous pneumonia and unilateral nature of the lesion, in addition to the fact that a pulmonary metastasis of a basal cell carcinoma was an unknown occurrence made an exploratory thoracotomy seem advisable.

Operation. November 21, 1922. Dr. Wyman Whittemore.

Under novocaine anæsthesia a curved incision was made over the fifth rib in the anterior axillary line revealing a small nodule in the muscles of the chest wall. This was excised, and a two-inch segment of the rib removed. The pleura looked opaque but the lung could be seen moving under it. It was firmly resistant, however, and at first glance gave the impression of a thickened pleura with adherent lung. The pleura was incised revealing a solid, grayish lung, a small segment of which was removed for diagnosis.

Pathological report. A spherical nodule from the muscles of the thorax, measuring 1.3 centimeters in

diameter, showed a white, sticky, translucent surface on section.

A small piece of tumor was removed from the lung, and, as observed at operation, the pleura did not appear thickened. The portion of the lung exposed seemed filled with white tumor, showing a translucent, sticky juice exuding from its cut surface.

Microscopic examination of the lung showed solid columns of atypical epithelial cells invading the walls of the alveoli. Occasional irregular gland tubules occurred in the centers of these cell columns.

A microscopic examination of the nodule of the chest showed columns of atypical epithelial cells invading the muscles and nerve sheaths. There were areas of gland tubule formation (Fig. 7). Mitotic figures were numerous in both specimens.

A review of all the sections from this case, since 1909, shows carcinoma, the cells of which differentiate mostly to the basal type, and occasionally to squamous epithelium.

Most of the sections show small gland tubules in the midst of the cell columns. These tubules are lined by epithelium, the cells of which have more deeply-eosin-staining cytoplasm than the surrounding epithelium forming the cell clusters. The tubules are often filled with mucus.

In general the cells become more atypical in the latter recurrence and are relatively in greater abundance than the stroma. The histological character is consistent with a primary tumor of the parotid gland.

Diagnosis: Metastases of adenocarcinoma of parotid in lung and chest wall. (Dr. H. F. Hartwell.)

The convalescence was uneventful and she was referred to the Huntington Hospital where she was given deep X-ray therapy over the left chest. The first treatment was followed by severe hæmoptysis but aside from this she experienced some relief from her dyspnœa and cough. Her last visit to the Huntington Hospital was on June 20, 1923, at which time she appeared to be rapidly losing ground. An X-ray treatment was followed by hæmoptysis so no further therapy is planned. The last report from the patient was on February 2, 1924, at which time her condition had not essentially changed.

SUMMARY OF HISTORY

The history given in detail above records the course of a tumor of the parotid, the excision of which was followed by eleven recurrences with as many secondary operations during the past 14 years. The second operation included complete excision of the gland and removal of the cervical lymph nodes, the subsequent operations have been local excisions with or without cauterization. Radiation both by X-rays and radium have been employed at intervals during the course of the disease. At the end of 14½ years, two years after the last operation, there is no evidence of local recurrence, but the left lung shows extensive involvement by metastasis of the tumor.

During the course of the disease and the many re-entries to the hospital, microscopical studies of the recurrent nodules of the tumor have yielded various differing pathological diagnoses, viz., cancer, cylindroma, sebaceous adenoma, basal cell carcinoma and epidermoid carcinoma of the hair matrix type. The tumor of the lung is recognized as metastatic adenocarcinoma.

In the records, the tumor has been classified clinically as carcinoma of the parotid, face, neck, ear, and temporal region, as epithelioma and as a mixed tumor.

COMMENT

The confusion in both pathological and clinical diagnosis obviously arose from the tendency of an adenocarcinoma of the parotid to differentiate as a so-called cylindroma. The many recurrences show successively an increased tendency toward this basal cell metaplasia and a corresponding decrease in alveolar structure. The origin of the tumor is not entirely clear. The encapsulation of the growth noted at the original operation, the marked tendency toward basal cell metaplasia, the hyaline deposition in the stroma, the lack of lymphatic extension and final occurrence of metastasis by the blood stream, and the long duration of the disease, all suggest that the tumor is related to the group of mixed tumors. On the other hand, the acinar structure seen in the recurrences and predominating the metastases, the production of mucoid secretion, the relatively rapid growth of the tumor at the time of onset (1½ years), and the early pre-operative involvement of the facial nerve, are in favor of a primary parotid carcinoma. We believe that the weight of evidence favors a classification as a malignant mixed tumor, although a pre-existing quiescent stage cannot be demonstrated clinically or histologically.

As interesting features may be mentioned, the completely unilateral distribution of the pulmonary metastasis, on the side opposite

that of the tumor, and the diagnosis of malignancy of the lung by the aspirating needle.

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CLINICAL OBSERVATIONS ON THE ETIOLOGY OF GALL STONES IN WOMEN

By V. L. SCHRAGER, M.D., Chicago

THIS paper covers observations made over a period of 15 years, during which time I was able to verify many facts based upon clinical study and operative proofs. The first case which came to my attention I saw in 1908. The patient was a young woman of 19 years, with an excellent health record up to the time of her first pregnancy. Four days after a normal delivery she exhibited a stormy syndrome closely resembling gall-stone colic. She had repeated typical attacks thereafter and finally, 8 years later, an exploratory laparotomy confirmed the original diagnosis of gall stones. Since treating this case I have seen similar conditions in very young women, shortly before or after the first pregnancy.

The thesis I wish to advance is that cholecystitis in women, in a large number of cases, originates during the first pregnancy, that in many cases it passes unrecognized, and that the gall stones of middle life, very likely, are the end-product of cholecystitis originating during the first pregnancy.

Every clinician is familiar with the fact that cholecystitis occurs more frequently among women than among men and that there is a close relationship between pregnancy and the presence of gall stones. My reason for reopening this subject is that I believe statistics underrate the frequency of cholecystitis in women; that the statistics which establish the period of occurrence of gall stones in women are based upon operative and postmortem findings. Such information, however, does not establish the actual origin of the disease. I believe that the ratio of cholecystitis in women as compared with men, which is given as four to one or five to one, must be questioned. The etiological factor of cholecystitis persists so overwhelmingly in women, that one is at a loss to interpret the statistical data.

The first intimation of the relationship between pregnancy and cholecystitis was made by Huchard in 1882 and Cyr in 1883. Dieulafoy, in 1898, laid great stress on this relationship and his views were supported by information gathered from the large obstetrical clinics of Tarnier and Pinard. Not only pregnancy, but the entire sexual period of married woman and her mode of life seems to be closely interrelated to the development of cholecystitis. American literature has a great enthusiast in Reuben Petersen. He expresses surprise that the literature records so few gall stones during pregnancy and the puerperium, when the frequency of gall stones in women is borne in mind. Schauta and P. Muller deal with the subject in a few words; the matter receives meager consideration in the large work of Winckel's *Handbuch der Geburtshilfe*. In order to appreciate the evidence, one must be permitted to review all the etiological factors of gall stones.

INFECTIOUS FACTORS

Of all types of organisms, the typhoid bacillus is present most frequently. It is found in the gall bladders of patients who have or have had typhoid fever. Old calculi occasionally yield the organism from their nuclei. The same holds true of the organisms of the colon family. These facts have been proven conclusively by Futterer, Naunyn, Blachstein, Welch, Koch, Gay, Claypole, and others. Clinically, however, one very seldom sees a case in which the typhoid etiology is present. It is no longer a clinical routine to ask a gall-stone suspect whether he has had typhoid. We know now that typhoid is gradually disappearing whereas gall-stone cases are multiplying in number. Besides, various investigators have found that the sources and avenues of infection are so varied and so numerous that typhoid is rather an exceptional factor in the causation of cholecystitis. The liver and its appendages are, indeed, a hub toward which infective material radiates from numerous sources. Infection

may reach the liver, the gall bladder, and the bile ducts by way of the blood stream from a focal source, or along the tributary vessels from a local abdominal source—the duodenum and small intestines for example. By emulsifying and culturing pathological gall bladders, R. O. Brown, under the guidance of E. C. Rosenow, found the streptococcus to be the chief agent of infection. The organism thus obtained showed an elective affinity for the gall bladder of animals, and he concludes that cholecystitis "is commonly a blood-borne infection from a focal source."

Some hold that infection can be carried along the hepatic artery (Branson). Adami contends that organisms, which are picked up by the leucocytes during the process of digestion, are carried into the radicals of the portal vein. J. Earl Else does not share this view. Wrzosek believes that organisms may travel into the thoracic duct by way of the lacteals. Branson, Else, and others think that the infection may start in the duodenum and then progress along the common or cystic duct. This possibility can scarcely be accepted, on account of the sterility of the duodenal contents and the resistance of the common duct to the entrance of duodenal material. Personally, I have been impressed by the frequency with which gall-bladder disease is associated with some definite pelvic pathology, a fact which has been oberved by a good many other clinicians. In the course of routine palpation of gall bladders in a series of 542 laparotomies, Reuben Petersen found that 64, or 11.8 per cent, had gall stones; of these, 48, or 75 per cent, had borne children. Some of these patients came to the operating table chiefly for gynecological reasons. Kelly intimates that puerperal infections may be an etiological factor of gall stones. In several experiments, I have attemped to ascertain whether or not organisms from pelvic infections may reach the gall bladder, either by direct extension or by an affinity for the gall bladder in the sense of Rosenow's views. The cultures for these experiments were obtained from severe cases of puerperal sepsis, and they killed the animal so rapidly that it left no room for any conclusion. However, if one may have the privilege of speculating, I should like to advance the view that it is possible that certain strains of organisms from pelvic infections may have the same affinity for the gall bladder as Rosenow's streptococcus has for the same organ. There is room and opportunity for experimentation in that direction.

Whatever the source or type of the infection may be, bile is usually sterile when its flow is unhampered. Pregnancy, crowding the intestines against the biliary passages, occasionally kinking or obstructing them, coupled with the slowing of diaphragmatic excursion, is conducive to stasis. This phenomenon interferes with the physiological rate of expulsion of bile, which favors bacterial invasion and growth.

CHEMICAL FACTORS

What was vaguely considered gall-stone diathesis by Dieulafoy and others is, according to Schade (1910) and Riedel (1912), a hypercholesterinæmia. Cholesterin is kept in solution as long as bile flows at regular, physiological intervals. Stagnant bile throws cholesterin out of solution and it precipitates in the presence of bacteria. The cholesterin content of the blood in pregnancy increases with the progress of pregnancy, drops in the first few days after delivery, increases again thereafter and becomes normal after 2 months. The clinical facts correspond exactly to these chemical variations. Before I became familiar with these biochemical changes in pregnancy, I observed that dyspeptic symptoms are more common in the latter period of pregnancy (sixth to the eighth month) and that these symptoms, or actual attacks, recur shortly after delivery. In other words, there is a strong parallelism between the physiological facts and the clinical course of cholecystitis antepartum and postpartum. Hypercholesterinæmia of old people may explain, in part, the frequency of gall stones occurring in both men and women in advanced ages.

MECHANICAL FACTORS

Among the mechanical factors which, directly or indirectly, contribute to gall-bladder pathology, are the following: A large uterus

and abdominal tumors, especially fibroids, interfering with the emptying of the gall bladder either by increasing the intra-abdominal pressure or by hindering the diaphragmatic excursion. Reuben Petersen states: "It is significant that in one-third of the patients the onset of the attack is at the period of gestation when the uterus is approaching the level of the umbilicus, when as an abdominal organ it is beginning to crowd the uterus toward or upon the bile passages." In a series of fifty cases of gall stones Mosher found that 13 or 22.4 per cent had fibroids. In a group of 1,232 operations for uterine fibroids at the Mayo Clinic, 92, or 7.1 per cent, had gall stones. Myake ascribes the scarcity of gall stones among Japanese women to the fact they they do not wear corsets. Enterovisceroptosis plays a great rôle in the formation of gall stones. In his *Anatomy of Glenard's Disease*, Keith mentions that gall stones are almost invariably present in this condition.

PHYSIOLOGICAL FACTORS

There is an actual physiological upheaval in pregnancy. As stated by the Mayos, the liver of man is one-thirty-sixth of the body weight, while the liver of woman is one-fortieth of the body weight, which implies, in a measure, that the liver of woman is less active functionally. Since the liver of pregnant women functionates for both mother and child, and has to labor with its own as well as fetal metabolism, it is necessarily overtaxed physiologically and has a diminished resistance to infection. Branson makes a similar implication and emphasizes the rapidity with which this overtaxation takes place. Goldsborough and Ainley have shown that the power of eliminating toxic material is below par in the latter months of pregnancy. Actual liver changes occur during pregnancy, as testified by the great frequency with which jaundice occurs during cholecystitis of pregnancy.

The inefficient contractions of the diaphragm, as well as those of the abdominal muscles, tend to slow the current of bile, which invites precipitation and bacterial invasion. Both men and women who live on a liberal fat and albuminous diet may show a cholesterin diathesis which favors the production of gall stones.

MISCELLANEOUS FACTORS

Branson suggests that the various psychic phenoména during pregnancy affect the liver as they affect the thyroid gland. One must readily accept the fact that the anticipation, the hardships, and the suspense of the long period of pregnancy, are capable of disturbing women psychically.

In addition to the above factors, the sedentary mode of life, and particularly constipation, which is far in excess of that in men, also predispose women to cholecystitis.

If all the factors mentioned occur with definite constancy in women, we should be able to record more cases of cholecystitis among women and a great many more as compared with men. These factors also suggest that if there is any relation between them and the causation of gall stones, they must necessarily occur, in a large measure, during the first pregnancy. While the subsequent pregnancies may also show all these tendencies, it is fair to assume that woman has developed a sort of an adaptation to all these disturbing factors which does not exist during the first pregnancy.

It is incumbent upon the clinical historian, whether medical student, interne, or clinician, to go into the most minute details of the sexual life of women, especially during the first pregnancy, and record all the discomforts or actual attacks of abdominal pain, as they may have a bearing upon the ultimate diagnosis in the case. It is very seldom that the upper abdominal symptoms occurring during pregnancy are properly estimated, because they do not assume the character of a frank attack, especially when occurring in very young women. There still are many physicians who cling to the old idea that gall stones is a disease of middle or advanced life. My experience is quite the contrary. I have seen quite a large number of cases of cholecystitis occurring in patients below the age of 30, and I have been able to follow many cases from the original cholecystitis of early life to the clean-cut picture of gall stones exhibited in middle life. True enough, the clinical picture

of cholecystitis occurring during the first pregnancy is not clean-cut and may manifest itself either in the form of vague dyspeptic symptoms, or it may assume the character of a genuine colic; it may be confused with other stormy yet transient clinical pictures which occur during the latter months of pregnancy or postpartum, such as intestinal colic, colitis mucosa, after-pains, puerperal sepsis, appendicitis, pyelitis, etc. Branson speculates that the usual symptoms which accompany early pregnancy, such as morning sickness, water brash, sour stomach, and nausea, may be of hepatic origin. It was, indeed, a revelation to clinical medicine when Moynihan called the attention of the profession to the fact that the dyspeptic train of symptoms is the first indication of gall-bladder pathology. In the case of Rose, the gall bladder ruptured during the second stage of labor. Sudden pain, shock, and collapse are present in both conditions, and it is both logical and excusable to suspect rupture of the uterus. The presence of chills, fever, and abdominal pain following delivery may suggest sepsis. This was the case in a patient of Pinard in which a forceps delivery was followed on the third day by such symptoms, which masked an acute gall bladder, upon which operation was delayed until the tenth day. A case of Vineberg in which general abdominal sepsis was suspected, proved to be a ruptured gall bladder.

Instead of burdening the reader with a complicated tabulation of cases, may I be permitted to give a composite picture of the cholecystitis of the first pregnancy as I have seen it in most cases? The patient is usually a young woman between the ages of 18 and 25, with a previous clean bill of health; she marries and becomes pregnant within a few months after marriage. She gains in weight rapidly, adding 15 to 25 pounds. During the seventh month of pregnancy, occasionally as early as the fifth, but most commonly during the seventh and the eighth month, she complains of a vague abdominal distress, either in the epigastric region or in the right hypochondrium, lasting from a few minutes to 1 hour. Occasionally, she has a genuine colic. It is quite unusual to have these attacks occur during the actual delivery, although I have seen several such cases. Between the third and seventh day postpartum, these attacks may recur. My experience has convinced me that in some cases the attack is of such short duration that the attending physician does not have a fair chance to witness it. The nurses and the internes either make light of it, or they fail to grasp its significance. It is a common occurrence to charge these "spells" to indiscretion of diet, too many visitors, and what not. The patients leave the hospital and continue to have such "spells" at home. In about half of the cases the attacks abate and to all practical purposes disappear for the time being. Very few come to operation within the first 3 months after delivery, because it is hard to convince not only the patient but frequently the attending physician himself, that the young woman has gall stones. In the remainder of the cases, these young women come to operation between the ages of 25 and 30, after they have undergone various types of non-operative procedures.

I have operated in several cases very shortly after delivery and I have found that in a few cases the gall bladder contained either a putty-like mass or a fair number of very small concretions. There is a group of patients who invariably yield a single date-like stone, tightly impacted in the cystic duct. The attack is violent with localization in the right hypochondrium, and distressing respiratory embarrassment.

CONCLUSIONS

Cholecystitis of middle adult life in women, in a large number of cases, traces its origin to the first pregnancy and as such, it must be recognized as a distinct clinical entity. If this conclusion is supported by observations of other clinicians, it may tend to destroy the clinical superstition that young women do not have gall stones. It may train the medical student, the interne, and the general practitioner to link the vague abdominal phenomena occurring during the first pregnancy and recurring during the subsequent pregnancies with the clinical finality of the gall-stone picture present in patients between the ages of 35 and 45 years.

THE INDICATIONS AND RESULTS OF THE INTERPOSITION OPERATION IN THE TREATMENT OF CYSTOCELE AND PROLAPSE OF THE UTERUS[1]

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THAT the numerous operations devised for the correction of prolapse of the uterus and cystocele are unsatisfactory is proved by the high percentage of recurrences following their performance. Many of them are based on ingenious and elaborate denudations or complicated applications of sutures, and though some, notably the Hegar, Stoltz, and Alexander operations, give good primary results, as do the other plastic procedures, the end-results of none are entirely satisfactory. The reason for their failure is not far to seek. They do not take into consideration the anatomical relations of the pelvic fascia, with the underlying causes of the injuries they seek to correct, and they fail to appreciate that prolapse of the uterus and cystocele are nothing more than herniæ through the pelvic canal.

In order to understand the pathology of uterine prolapse and cystocele, it might be well to compare the relations of the pelvic canal with those of the inguinal canal. The inguinal canal leaves the body obliquely and is protected largely by internal pressure outward against the abdominal wall. Any structure passing through this canal must pass obliquely and must be subjected to the natural physical and anatomical factors that protect the openings of the body. These same considerations hold true in the study of the pelvic organs. The vaginal canal is similarly protected and leaves the body in an oblique or curved direction. The strong fascial sheets under the bladder, which we usually term the vaginal plate, connect with the structures at the base of the broad ligaments, and intra-abdominal pressure is exerted behind the symphysis pubis and has a tendency to act on the uterus, or, more correctly, the fundus of the uterus, and throw it forward on the bladder. Structures leaving the abdomen by the vaginal canal, therefore, must pass behind this anterior vaginal plate, but when it has been injured by the trauma incident to labor, the canal is practically straightened out and descensus of the organs is the natural consequence.

Cystocele occurs by reason of injury to the anterior vaginal plate, and the bladder gradually sags because of the retracted fascia. Cystocele, therefore, is nothing more than a hernia, and any operation for its correction, to be successful, must either restore the fascia underlying the bladder, or must fill in the opening by some structure that will provide a firm base upon which the bladder may rest. The injury of this plate, together with an injury of the strong fascia covering the levator ani muscle, causes an associated condition of rectocele, though it must be borne in mind that prolapse of the uterus and cystocele are not necessarily associated with perineal tears.

These conditions may occur n nulliparous women, but they are due in such cases to developmental errors and present individual problems that may be disregarded for the purposes of this paper. They most frequently follow the injudicious use of forceps before the cervix is fully dilated. The cervix is thus stripped away from its fascial attachments and the entire fascial planes of the pelvis are thereby weakened and attenuated. A similar condition may arise, however, when the patient has not been delivered by forceps, but in every such case a history of tedious, protracted labor will be elicited, in many instances with an unusually large child.

It is evident from these facts that any operation for the correction of prolapse of the uterus and cystocele must be based upon the idea that the chief support of the pelvic viscera is the ligamentous attachments. This has been repeatedly proven by the failures that follow the various suspension operations, and

[1]Read at the meeting of the Mississippi State Medical Association at Vicksburg, May 9, 1923.

even the firm fixation of the fundus of the uterus to the abdominal wall by various operative procedures. Prior to the development of the Watkins operation, or, as it is more commonly known, the interposition operation, no surgical procedure was entirely satisfactory for the relief of cystocele and prolapse. Even vaginal hysterectomy failed, because, while it eliminated one source of trouble, the prolapsed uterus, it failed to correct either the cystocele or the rectocele, and many cases ended in an even greater degree of rectal and vesical sacculation.

The Watkins operation has been in use since 1898, long enough, therefore, to study the end-results of large series of cases, and it is commonly agreed that it is the ideal procedure in selected types. Its results are more uniformly successful than those of any other operation devised for the cure of these conditions, and it does not present the difficulties encountered in many of the other procedures, notably that of Goffe, which was objectionable largely because of the extensive dissection and trauma to which the bladder was subjected. The details of this operation are so well known and its technique is so standardized that it is not necessary to elaborate either of these points, but it might be well to point out again the cardinal principles upon which it is based:

1. The bladder rests upon, and is supported by, the posterior wall of the uterus.

2. The uterus is elevated in the pelvis by being tipped forward, its position being changed about 180 degrees.

3. The twist produced in the broad ligaments by the change in the position of the uterus perceptibly shortens them, and is the chief factor in correcting the uterine prolapse.

4. The tendencies of the uterus and bladder are antagonistic to further prolapse, as they work against each other to hold the correct position.

It can be seen from this that the most important point of the operation is the relief of the cystocele, the bladder being usually the only organ the function of which need be considered at the age at which the operation is most frequently performed, but that in its correction the prolapse of the uterus is also corrected by the change in its position. The basis of the operation is the utilization of fixed structures for support, and it not only avoids the removal of a uterus that is not pathological in itself, but employs it as a plug for the hernial opening, and a shelf, as it were, to hold the bladder in place.

The same care must be exercised in the selection of cases for the interposition operation as in any other operative procedure. It is by no means possible to correct all degrees and types of prolapse by this method, and certain considerations must govern our choice of cases, particularly the cleavage plane of descent, the size and condition of the uterus and cervix, the degree of prolapse of the vaginal walls, the age and social condition of the patient, as well as the general abdominal condition and the presence of a visceroptosis. One case may present a hernia through the vesical plane of the fascia, with cystocele as the chief feature, in another the descent may have occurred through the postpubic plane, and still another may be due to lacerations through the rectovaginal sheet, with rectocele as the main condition. Many authorities do not believe that the operation is of value when the prolapse has occurred largely through the rupture of the rectovaginal fascia, but this is contrary to my own experience, for in many cases I have combined the operation with a repair of the rectovaginal structures, with complete success. Some cases in my series which presented a picture of procidentia with practically complete inversion of the vaginal walls were permanently relieved by the combined operation. Such cases, however, are the exception, and usually when complete procidentia exists, it is better, unless the patient refuses hysterectomy, as happened in two of my cases, to resort to the Mayo operation, vaginal hysterectomy, with the utilization of the base of the broad ligaments for supportive structures.

The size of the uterus and its condition are other points to be carefully considered. The hypertrophied uterus, so common in long standing displacements, cannot be successfully utilized as a support for the bladder, but the size may be greatly reduced by a high amputation of the cervix, which is indicated

in all cases where the cervix is hypertrophied or elongated, or protruding through the vaginal orifice. This procedure also makes it possible to include in the sutures at the side of the uterus the fascia which has been stripped loose. A partial resection of the uterus is also possible; it is bisected laterally, the mucosa being thoroughly removed, and the posterior half used for the reconstruction of the anterior vaginal plate. In a few instances I have even done a supravaginal hysterectomy, removing possibly two-thirds of the fundus by a wedge-shaped incision, and leaving just enough to fill in the desired space under the bladder.

The age and social condition of the patient are also important points. The operation is never applicable to women in the childbearing period, unless there are special indications for its performance and the patient will consent to sterilization. Resection of the tubes should be done and the stumps carefully buried. Unless this precaution is taken, distressing complications may arise should a subsequent pregnancy occur. If the patient will not consent to sterilization, temporizing measures, or possibly some of the other operative procedures the success of which is questionable, must be adopted. The interposition operation is especially indicated in women near or past the menopause, at which age the conditions most commonly arise, who present a small uterus, with the cervix hypertrophied and a cystocele the prominent feature.

The operation should always be combined with a repair of the perineal floor, otherwise there is a tendency for the uterus to rotate on its axis and prolapse will recur. If the broad ligaments are unusually long, the bases should be cut away from the sides of the cervix and sutured together in front, in order to readjust the normal relations of the cervix to the posterior vaginal wall. This is superior to shortening the uterosacral ligaments, because they are usually very much attenuated in cases of long standing prolapse, and the operation necessitates opening the posterior vaginal vault. Other abdominal and vaginal conditions may be corrected at the same time.

In the early cases in which I performed this operation the morbidity encountered was due to errors in judgment and to a faulty selection of cases, but experience has corrected this to a large extent. Vesical disturbances occasionally occurred because of the incorrect coaptation of the structures and the suturing of the fundus of the uterus too far forward under the symphysis. Urethral disturbances followed, and an occasional vesical complication which was sometimes rather difficult to control. Imperfect hæmostasis is a potent factor in producing postoperative complications, and can be overcome by various simple measures such as employing blunt dissection with scissors, etc. Cystitis occurred more frequently in the early cases than in the later series because it was then considered necessary to make a wide separation of the bladder, somewhat as in the Goffe operation; this has since been abandoned and bladder complications are now largely eliminated.

My experience with this operation is based upon approximately 80 cases in private practice, and a fair number in a large gynecological service in a public clinic. Of these, 50 consecutive private cases covering the last 10 years have been analyzed for this paper. During the period, 1912–1922, at least twice as many cases of cystocele and uterine prolapse were treated by other methods, an indication that the interposition operation does not suit every case in which these conditions occur. Two patients were 33 years old. Each gave a history of several tedious instrumental deliveries, each was very stout and had extensive lacerations of the pelvic floor. One had a very large cystocele, the other had a large umbilical hernia, a bladder diverticulum, and an almost complete prolapse. Both were suffering extreme pelvic discomfort, and the only alternatives were hysterectomy, which was emphatically refused in both cases, or the interposition operation with sterilization. The age of the other patients varied from 40 to 73. Three were over 70, and the majority were between 45 and 55. Thirty had passed the menopause and 10 others were having menopausal symptoms. In the patients over 70 the operation was performed because of the aggravated bladder symptoms. Formerly, in patients of this age, if operation was advised or performed, the Stoltz operation was selected,

which consisted of the denudation of an area on the anterior vaginal wall and the use of a purse-string suture. The result was rarely satisfactory because of the recurrence of the cystocele. The interposition operation can be performed in these cases, under local anæsthesia if indicated, with surprisingly little discomfort and uniformly good results.

The question of previous pregnancies is interesting. All of the patients in this series had borne children, the number varying from one patient with one previous pregnancy to one patient with sixteen. The abortions and miscarriages ranged from one in seven patients to seven in one patient. It is interesting to note that in more than 50 per cent of the series there was a history of one or more tedious forceps deliveries. Nine patients had complete procidentia of the uterus, 17 had herniæ of probably one-third to one-half of the bladder capacity, all had vesical symptoms of some sort, and 5 had almost complete incontinence. Six had had previous unsuccessful plastics, from 3 to 20 years before this operation was performed. Two of the operations were done under local anæsthesia, and all were followed by perineorrhaphies. Sterilization was done in every case in which there was a possibility of subsequent conception. Myomectomy was done in 3 cases, umbilical herniotomy in 2, femoral herniotomy in 5, lipectomy in 3, hæmorrhoidectomy in 10, amputation of the cervix in 24, supravaginal hysterectomy in 2, and salpingo-oophorectomy in 1. One case was given an application of radium, hysterectomy being advised and refused.

There was one death, occurring in a patient 33 years old, whose condition was previously described. An amputation of the cervix was done, anterior and posterior colporrhaphy, an umbilical herniotomy, lipectomy, and sterilization, in addition to the interposition operation. She developed postoperative pneumonia and died suddenly on the twentieth day. The wounds were in good condition and there was no evidence of infection. One patient developed a left thrombophlebitis 3 weeks after operation, the others made uneventful recoveries.

Thirty-nine of these 50 patients, 78 per cent, have been followed up from 1 to 10 years after operation. Thirty-six, or 93 per cent, report excellent health and complete relief of symptoms. Of the other three, one reports recurrent incontinence after 6 years of complete relief. She was 68 at the time of operation. One reports occasional incontinence after a shock or jar. The third was examined one year after operation, at which time the anatomical cure was perfect, but there was some frequency of urination. She later consulted a genito-urinary specialist, who reports a negative cystoscopical examination and some recurrence of the cystocele. Because of the strong neurotic element in the case he advises against any further surgery. Unfortunately, none of these three cases has been examined personally and therefore no reason can be given for the poor results.

Finally, in view of the excellent results obtained, ranging from 90 to 95 per cent of cures, it is natural to conclude that the interposition operation, combined with the correctly applied principles of plastic surgery of the pelvic floor, will result in a higher percentage of satisfactory results than any other operation so far devised for the relief of uterine prolapse and associated cystocele.

SYMPOSIUM ON HÆMORRHAGE

HÆMORRHAGE[1]

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WHEN I was honored with an invitation to participate in this discussion I readily accepted it, for hæmorrhage is a subject as practically important to the experimental pathologist and physiologist as to the surgeon. Most of your operations and nearly all of ours entail the loss of some blood. But while your patients often have a stock of 4 or 5 liters and may lose a few scores of cubic centimeters with impunity, some of our subjects may not possess a total stock of 20 cubic centimeters, and cannot lose many drops without detriment. And if we are trying to determine the effects produced upon an animal by such an operation, let us say, as the removal of the adrenals, we must be quite certain that the results, whatever they may be, have not been essentially influenced by the operative conditions, including hæmorrhage. Furthermore, the influence upon the various functions of the body of such considerable hæmorrhages as are in themselves of surgical importance and the remedial measures necessary to cope with them have been studied not only by surgeons, but as often, and sometimes in greater detail, by physiologists.

Some hæmorrhages may produce exceedingly important consequences and be accompanied by striking symptoms when the quantity of blood withdrawn from the circulation is so trifling that in itself the loss would cause no noticeable effects. Such are hæmorrhages into the brain or cord or into the pericardial sac. Here the gravity of the symptoms depends not upon the amount of blood lost but upon interference with important structures. It is the seat of the bleeding, not its amount, which determines its effects.

When a substantial but not an immoderate hæmorrhage is caused, till the loss of blood is perhaps 2 per cent of the body weight, it is seen that a number of compensating changes occur which maintain the arterial blood pressure practically at its initial level. A rather general vasoconstriction is brought about through the vasomotor center. The heart beats faster owing to the diminution of the tonus of the cardio-inhibitory center. For some little time the return of blood to the right heart by the veins is not diminished, and the filling of the ventricles and, therefore, their output not interfered with. This is due to the reduction in the capacity of the vascular system associated with the action of the vasomotors, the shrinking of the arteries, the partial emptying of the so-called venous cisterns, and the constriction, perhaps the temporary obliteration, of some of the venules and capillaries, both those through which an active circulation has been going on and those in which blood has been stagnating. An additional compensatory mechanism is the increase in the respiratory movements, which aids the venous return of blood to the heart.

To some extent the loss of blood is made up for by the entrance of fluid into the vascular system from the circulating and tissue lymph. Although this begins early, during or after hæmorrhage, it is a relatively slow process in comparison with the rapid adjustments brought about by the other factors mentioned. The possible influence of a redistribution of the water in the blood between the corpuscles and the plasma upon the circulatory condition, especially the viscosity of the blood, apart from the influence of an actual reflux from the lymph, must not be overlooked, although it is probable that it could not be more than a minor factor.

It is obvious that when the loss of blood reaches a certain point, the compensatory mechanisms will no longer suffice to maintain the filling of the heart, and the quantity of blood ejected per unit of time from the ventricles must decline (Meek and Eyster, 10; Burton-Opitz, 3, et al.). The changes

[1]Presented in the symposium on hæmorrhage before the Clinical Congress of the American College of Surgeons, Chicago, October 22–26, 1923.

have been followed in detail by a number of observers, especially by Wiggers (15). But the ultimate result is that the arterial blood pressure and, what is after all the important thing, the rate of blood flow through the organs is diminished by the falling off in the cardiac output, even in the case of those organs the blood flow of which has been previously cut down by vasoconstriction. The circulation through the brain begins to suffer especially, since it is closely dependent upon the maintenance of the general arterial blood pressure.

When the amount of blood lost is increased to as much as 4 per cent or more of the body weight, anything like adequate compensation even for a brief time, by the mechanisms described, becomes impossible. The vasomotor center becomes paralyzed. The blood pressure falls to a low level (40 or even 30 mm. of mercury), and the blood flow is markedly decreased. The rapidity of the hæmorrhage scarcely influences the level to which the pressure falls. This depends above all upon proportion of the total blood lost (Pilcher and Sollman, 12; Downs, 5; Zunz and Govaerts, 16). As might be expected, the proportion of the blood which must be withdrawn to establish a given low blood pressure varies considerably in different individuals.

It should be pointed out that as regards the acute consequences of hæmorrhage the loss of erythrocytes and not the loss of plasma is the important thing. This has been emphasized by Bert (2), Henderson (9) and others. More immediately important than the volume of blood circulating per minute is the mass of hæmoglobin circulating per minute. In the long run, of course, the plasma is essential for the proper nourishment of the tissues. But any decided interference with the transportation of oxygen (and in a smaller degree of carbon dioxide) due to the loss of the red corpuscles is reflected at once in an interference with the gaseous exchange of the organs. In the case of certain tissues, especially the nerve centers, the symptoms are marked and immediate, and most of the compensatory mechanisms referred to above are brought into action in response to changes in the nervous centers, due to interference with their internal respiration. Practically no stores of available oxygen exist in the tissues comparable to the stores of nutriment represented by the glycogen, certain of the constituents of the tissue lymph, and perhaps certain constituents of the tissue substance itself. So far as internal respiration is concerned, evolution in the mammal has chosen uncompromisingly the "hand to mouth" plan, in which, by means of a highly efficient transportation system (the blood circulation), the oxygen required at the moment is delivered at the moment, with next to no provision for a breakdown in the transporting mechanism.

If the real functional lesion in hæmorrhage is interference with tissue nutrition and especially with tissue respiration, as it certainly is, it becomes self evident that it is impossible to limit one's view to the circulatory changes alone. It is hardly to be supposed that anybody who has thought seriously upon the matter has ever stopped at the fall of blood pressure, or the diminished output of the heart or the diminished blood flow through the organs, without envisaging the consequences to the tissues of such interference with their blood supply, the more or less complete local asphyxia producing very rapid effects, the more or less complete deprivation of nutriment producing effects more gradual but yet inevitable. That would be like saying that in the war the damage caused to the Allies, and especially to England, by the German submarines was that they sank the *ships*, and that the loss of the *cargoes* and of the other cargoes which those ships would have carried had they remained afloat, and the consequent threat to the food supply of the nation and to its proper munitionment were of no importance. It was because of the loss of the things which the ships carried and the possible complete demoralization of the transportation system of England upon the seas, leading to her starvation as regards food and essential materials for the prosecution of the war that the submarine menace became so real. And when it is said that to the circulatory conception of hæmorrhage must be added a respiratory conception, it is something like saying that it was not only

ships which the submarines sank, but ships carrying cargoes or capable of carrying them. Nevertheless, it is by no means unnecessary or unimportant to insist, as among others Bert (2), and recently Henderson and Haggard (9) have done, that respiratory effects must and do result from the circulatory changes, and to endeavor to unravel some of these effects. Henderson and Haggard point out that "the symptoms and processes observable in a partially exsanguinated animal are identical in many essential features with those under progressive deprivation of oxygen, and with those occurring in carbon monoxide asphyxia. They are like those occuring in the process of acclimatization to great altitudes." They produced a "standard hæmorrhage" (0.25 per cent of the body weight each 5 minutes during a period of from 1 to 2 hours) which caused the blood pressure to fall to about 28 mm. of mercury. If the animal (dog) was then left to itself the chances were about equal that it would die or recover spontaneously. Transfusion of artificial solutions not containing erythrocytes was of little permanent benefit in comparison with blood. A marked decrease in the carbon dioxide content and of the alkali reserve was found to coincide with the increased pulmonary ventilation. Other observers (Gesell, 7, Tatum, 14) have also found a decline in the alkaline reserve capacity of the blood in hæmorrhage. This might indicate that the transfusion of an alkaline solution like sodium bicarbonate would be much superior to a simple sodium chloride solution after hæmorrhage. Forty years ago Hayem (8) found that the latter was of little avail after a hæmorrhage so severe that the animal would die if left to itself, whereas it could be restored by blood. Some observers have stated that sodium carbonate is not much, if at all, more successful; others (Dawson, 4; Henderson and Haggard, 9) accord it a somewhat higher place.

Concerning the merits of the gum acacia solution introduced by Bayliss there is much diversity of opinion. It has not won great favor among surgeons in America. Some laboratory workers state that it is not demonstrably superior to salt solution. For example, Penfield (11) in Howell's laboratory, failed to show that gum sodium bicarbonate solution or gum glucose solution was more efficacious in saving life than was an isotonic solution of sodium chloride. Erlanger and Gasser (6), on the other hand, report distinctly beneficial results from gum solutions in shock. If they are free from danger when properly prepared as claimed by their sponsors, they possess the theoretical advantage over simple salt solutions that the colloid remains longer in the blood and aids in retaining the water. The value of the greater viscosity of the gum solution has been overemphasized (13). If this factor favors an increase in the blood pressure it does so, of course, by making the blood flow through the tissues more difficult, and therefore slowing the flow unless the work of the heart is correspondingly increased. It cannot be assumed without proof that increase in the blood pressure is of advantage unless it carries with it an increase in the blood flow, which is the important thing for the nutrition of the tissues. With a given amount of work by the heart the rate of blood flow will be greater when the viscosity of the blood is less. Bayliss (1) has since admitted that he does not consider the higher viscosity of the gum solution an advantage. Some authors speak of such factors as increased vasoconstriction compensating for the diminished viscosity of the blood due to the increased proportion of the plasma after hæmorrhage. The diminution in the viscosity, which according to Opitz (3) develops more gradually than has been generally supposed, might rather be considered as compensating in some degree for the increased peripheral resistance due to the vasoconstriction and for the diminution in the venous return and the resulting diminution in the cardiac output. When blood is supplied by transfusion it is true that the liquid injected has a high viscosity. But that is not the reason for its unrivalled superiority to every other liquid. Its great virtue is that it supplies erythrocytes to the depleted circulation to carry oxygen to the tissues. It is the erythrocytes which are the principal factor in the high viscosity of blood. They are hard to drive through the capillaries. It is not because they are hard to drive that they

are valuable but rather in spite of it. It is worth while for the heart to force viscous blood through the tissues, because it constitutes the great transportation agency of the body. But it does not follow that it is worth while for the heart to force viscous gum through the tissues in lieu of blood.

In conclusion it may again be pointed out that a complete study of the effects of hæmorrhage must include not only the changes in the circulation, not only the changes in the mechanism and the chemistry of respiration, but all the physicochemical and even anatomical alterations of the various tissues with heir accompanying functional derangements. From this point of view it is the nervous system which is most important, because it is generally the nervous system which fails first, and whose serious failure is most irretrievable. While the period during which medical or surgical intervention holds out any hope in a grave and rapidly developing ischæmia of the central nervous system may often be measured by minutes, a period of hours may pass for some of the less susceptible tissues. It must, nevertheless, not be forgotten that renewal of an efficient circulation of good blood during this period may produce the most decisive effects. The question may also be asked whether if we knew more of the actual changes in the tissues caused by loss of blood, we might not sometimes be able by special measures even to raise a submerged center which could not be restored by transfusion of blood alone to the level at which renewal of an efficient circulation would completely resuscitate it. All studies of transfusion are at the same time studies on hæmorrhage, just as experiments on resuscitation are also experiments on normal function. For to know how the key acts when it locks the door is to learn something of how it acts when it unlocks it.

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POSTOPERATIVE HÆMORRHAGE[1]

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IT seems to me that, while I am not specially fond of hæmorrhage, I must have been selected to take this part in the symposium because I have so many opportunities for postoperative hæmorrhage, and so little of it.

What is more alarming, when one has just reached one's next appointment after a heavy morning in the operating room, than to receive a message that one of the operation cases is bleeding! Hurried instructions are given and all haste made to reach the afflicted one's bedside.

The greatest asset in the control of postoperative hæmorrhage is its prevention, and this is most successfully accomplished:

1. By a careful study of the individual case approaching operation.

   a. Is there a tendency to bleed, such as one finds in some of the secondary anæmias?

   b. Is there a history of hæmophilia in the family?

   c. Is there jaundice?

2. By meticulous care in the conduct of the operation to see that all bleeding points, or potential bleeding points, have been properly controlled before the operative procedure is completed.

In order to avoid confusion of terms let us understand what is meant by postoperative and what by secondary hæmorrhage. The former is the hæmorrhage that follows operative procedures where there has been a lack of proper study of the patient's previous condition, or where there has been some looseness in proper care upon the part of the surgeon during the progress of the operation. You know and I know that a "third degree" personally-conducted internal examination of one's own inner consciousness is oftentimes good for the soul, and more often good for the care of future patients. By secondary hæmorrhage is meant the old-fashioned kind met with in the years of long ago, and again during the world war when practically all wounds were infected. In such the vessels are ligated but, the infection continuing, it frequently happens that the ligated vessel sloughs before the intima has become fully sealed; the vessel again opens and further hæmorrhage occurs, often necessitating ligation at a higher level.

If one learns that a prospective operation case has a tendency to bleed upon slight provocation, one tests the clotting power of the blood and finding it poor, means are taken to improve this condition by resorting to direct transfusion, or the administration of horse serum, or the use of the calcium salts. When the clotting time has been improved, the operation may be undertaken with a fair degree of confidence.

In the hæmophiliac one hesitates to undertake any but the most imperative emergency, and in these a direct blood transfusion, either during or immediately following the surgical procedure, is the only thing that will give any confidence of safety.

Thanks to Walters of the Mayo Clinic, operations upon patients with jaundice may now be undertaken with comparative comfort. While we have known for years that the calcium chloride, if absorbed, would improve the clotting time of the blood, it remained for Walters to show us how and in what dosage it may be administered intravenously each day for three days, to gain the maximum of improvement, thus minimizing the risk of postoperative hæmorrhage in jaundiced patients almost to the vanishing point.

Painstaking care must be the watchword during the progress of all operation to see that all bleeding points are controlled. As one goes through the subcutaneous tissues, forceps are applied, turned over, and then left *in situ* until the completion of the operation. When they are removed the vessels are sealed and one has avoided a multiplicity of knots in the wound. If muscle fibers are separated and muscular branches are divided but not sufficiently damaged to cause clotting, they are caught and secured by a single half knot of No. 0 catgut, thus avoiding further laceration

[1] Presented in the symposium on hæmorrhage before the Clinical Congress of the American College of Surgeons, Chicago, October, 22–26, 1923.

and damage to the muscles and at the same time preventing many a hæmatoma.

For larger vessels some surgeons depend upon the ligature, and a few upon torsion. Let me here pay a tribute to my old preceptor, the late Dr. W. T. Aikins, one time professor of surgery in the University of Toronto. He was a marvellous surgeon in his time and had the courage of his convictions. He had learned his surgery in infected wounds for he began practice in pre-antiseptic days. He learned too the dangers of sloughing of the ends of ligated vessels and of secondary hæmorrhage following; hence he began to practice torsion of the large vessels. Many times I have known him to practice torsion of the femoral artery in Scarpa's triangle, and just as many times, as the forceps were removed, I was ready to "stand clear," but the vessel always held.

For the control of hæmorrhage at the time of operation, and for the prevention of post-operative hæmorrhage, let me commend to you the running suture, consisting of a double strand of No. 1 or No. 2 catgut threaded on a round semi-curved needle. Since 1906 I have not used a ligature in thyroidectomy, and it was before adopting this method that I had a postoperative hæmorrhage from a ligature slipping. There has been no such unhappy accident since. There is nothing to equal it in hysterectomy. I wonder how many here have had the ligature on the uterine artery slip at some inconvenient moment! For control of the pedicle in nephrectomy or splenectomy as well as in many other conditions, the running suture has no equal.

In an extensive bowel resection it has a double advantage for, as the cut edge of the mesentery is sutured and the suture made snug, it not only controls the bleeding but when tied one finds the cut ends of the bowel lying side by side ready for the anastomosis, and there is no gap in the mesentery to be closed.

And when such a running suture has been used and all hæmorrhage has been controlled, it is a great comfort to know, as the patient is returned to bed, that no matter what complications may arise, postoperative hæmorrhage will not be one of them.

HÆMORRHAGE FROM THE STOMACH[1]

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HÆMORRHAGE from the stomach is a serious problem for the practitioner of medicine. It is important for us to carry to the bedside a working knowledge of the causes which produce it, the clinical evidence by which we may recognize the various pathological processes responsible for its occurrence, and an accurate evaluation of the medical and surgical therapy which has been evolved up to this time so that we can give the patient suffering from such an accident the benefit of the best treatment that modern medicine affords.

It is, as a rule, not difficult to establish the fact that a patient has hæmorrhage from the stomach from the fact that he vomits up blood and by excluding such conditions as bleeding from the mouth and nose and pharynx and the respiratory tract by careful history and examination. We must also exclude cases of hysteria where an effort to simulate vomiting of blood is sometimes made. There are also some cases of stomach hæmorrhage which are not associated with the vomiting of blood, but in which the blood is all either retained in the stomach or forced into the intestines. Some of these cases are fatal, the patient dying in shock with the picture of internal hæmorrhage and the cause of the condition not recognized clinically but found at the postmortem examination.

There are a large number of pathological processes which may produce hæmorrhage from the stomach. Some of these are rare. I shall tonight in the limited time assigned to me discuss the common and usual forms which we must consider in making a differential diagnosis at the bedside. These causes are: a, peptic ulcer—gastric, duodenal, jejunal; b, carcinoma of the stomach and other neoplasms of the stomach; c, cirrhosis of the liver; d, diseases of the spleen, especially splenic anæmia; e, jaundice; f, hæmophilia; g, postoperative bleeding; and, h, hæmorrhage from the stomach in the newborn.

Peptic ulcer is the most common cause of gastric hæmorrhage. The hæmorrhage may occur as a massive hæmorrhage or as a chronic recurring hæmorrhage which may eventually produce profound anæmia. About 5 per cent of ulcer cases die of hæmorrhage. Payr believes that 93 to 97 per cent of cases of gastric hæmorrhage can be controlled by medical management. Fifteen or twenty years ago many operations were performed for hæmorrhage of the stomach. Moynihan advocates gastro-enterostomy as a means of controlling gastric bleeding. E. Wyllys Andrews, of Chicago, operated upon a number of cases attacking the lesion direct with ligature and suture. Some surgeons excise the bleeding ulcer and óthers cauterize the lesion. The mortality was very high and these operations were soon generally discarded. Recently Finsterer, who has done many stomach resections, has revived direct surgical attack in gastric bleeding and advocates resection under local anæsthesia. Most surgeons advocate medical management in the face of severe gastric hæmorrhage. This should be absolute rest, morphine, washing out the stomach, rectal fluids, alkalies to neutralize the gastric juice and ice bags over the abdomen, and, in selected cases, transfusion.

The logical reasons for adopting this treatment are: First, that few die in the first attack. Second, these patients are very bad subjects for a severe operation such as the direct attack of the bleeding point and ligating or cauterizing it or resecting the ulcer. Third, in many cases of gastric hæmorrhage the operation fails to reveal the bleeding point and is futile.

In cases of profound and deepening anæmia from chronic hæmorrhage, I believe that if any operation is done it should be a jejunostomy done under local anæsthesia. This enables us to put the stomach at absolute rest and at the same time feed the patient. I was able once to save the life of a patient whose hæmoglobin had gone down to 17 per cent.

[1] Presented in the symposium on hæmorrhage before the Clinical Congress of the American College of Surgeons, Chicago, October 22–26, 1923.

In bleeding from carcinoma and other neoplasms in the stomach, the question is not so much the hæmorrhage which is not often fatal, but the question of the removal of the neoplasm. Gastric hæmorrhage from cirrhosis of the liver is a dark chapter. The only cases which can be influenced by treatment are the cases where the cirrhosis is due to syphilis, and here iodide of potassium and mercury should be employed with occasionally marked improvement or even cure.

Splenic anæmia is a common cause of gastric hæmorrhage. Hæmatemesis in cases of leukæmia and hæmolytic jaundice are rare. Balfour, of the Mayo Clinic, in an excellent article on Hæmatemesis, analyzes cases of hæmorrhage from lesions of the spleen and finds that 50 per cent of the cases of splenic anæmia vomited blood but that enlargements of the spleen from leukæmia and hæmolytic jaundice were seldom associated with gastric hæmorrhage. In splenic anæmia with gastric hæmorrhage the clear indication is a splenectomy after the patient recovers from the attack of bleeding and fortunately, the prognosis is good. Most of the cases are cured by the operation if it is done fairly early before too extensive changes have taken place in the spleen and liver. In jaundice, in cholæmia, we not infrequently have hæmorrhages and sometimes gastric hæmorrhage. The clinical interest, however, in these cases centers around the bleeding that occurs after operation and the means which we can employ to prevent this complication. The accurate determination of the coagulation time is of great importance. Where this is slow, we can use chloride of calcium or direct transfusion. Balfour states that, in the Mayo Clinic, Walters, following the recommendation of Lee and Vincent in their article published in the *Archives of Internal Medicine* (1915) on "The Relation of Calcium to the Delayed Coagulation of Blood in Obstructive Jaundice," has been able consistently to reduce the coagulation time of the blood by daily intravenous injections of 5 cubic centimeters of 10 per cent of calcium chloride solution for a period of 3 days.

Hæmophilia is a cause of gastric bleeding, but a rare cause. When it does occur the best treatment, in addition to the recognized general management of gastric hæmorrhage, is the subcutaneous or intramuscular injection of from 20 to 40 c.cm. of human blood, and this may be repeated several times, and in serious hæmorrhage direct transfusion should be employed.

Gastric hæmorrhage in the newborn occurs sometimes with and sometimes without an associated jaundice. The pathology is not fully understood. The best treatment is the intramuscular injection of human blood, 10 to 30 cubic centimeters, and this is sometimes strikingly successful.

And, finally, I desire to refer briefly to gastric hæmorrhage which occurs after operations. We can easily understand the cases which occur after operation on the stomach, such as resection and gastro-enterostomy. Here some failure in technique is usually responsible. The employment of interrupted, instead of continuous suture, is a common cause. The employment of the three-row continuous suture of the Billroth school is the best method to guard against this accident. Reoperation in the face of postoperative gastric hæmorrhage is a trying ordeal and is usually futile. In addition, however, to these cases of stomach hæmorrhage there are cases of hæmorrhage from the stomach which occur after abdominal operations in which the stomach was not involved. These have been noted by von Eiselsberg and regarded as due to thrombosis of abdominal veins.

In conclusion, I desire to emphasize the importance of carrying to the bedside of the patient with gastric hæmorrhage a working knowledge of the pathology of the lesions and conditions which may produce it and the importance of determining, if possible, in each individual case just what the cause is so that we may give the patient the benefit of rational and scientific therapy.

HÆMORRHAGE IN THE GENITO-URINARY TRACT[1]

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HÆMORRHAGE in the genito-urinary tract, which is manifested by hæmaturia, like hæmorrhage elsewhere, is only a symptom and should be considered accordingly. It is always pathological and never physiological, even though its presence may be detected only by a microscopical examination. Hæmaturia is rarely accompanied by much discomfort and is generally intermittent. The importance of its presence, therefore, is apt to be underestimated not only by the patient, but also by the attending physician, in spite of the fact that the presence of blood may indicate a serious general disease or a lesion somewhere in the urogenital tract and should therefore be considered as a very important diagnostic sign.

An alarming hæmorrhage from the urogenital tract seldom occurs except in cases of trauma. A very slight injury may cause the rupture of a kidney or of the urethra with a resultant serious hæmorrhage. It sometimes happens, however, that a hæmorrhage from some cause other than traumatism, may be so profuse as to demand immediate operation and blood transfusion to save patient's life.

Before a final decision is made that the source and cause of the bleeding is in the genito-urinary tract, a careful history should be taken and a complete physical examination made, for in a certain percentage of cases, hæmaturia is due to some pathological condition outside the urinary tract. The ingestion of certain drugs such as cantharides, turpentine, phenol, urotropine, etc. may be the primary cause of the hæmaturia. A very interesting case has been reported recently by Ockerblad (5) in which a very marked hæmaturia resulted from the ingestion by the patient of a lead and zinc oxide mixture intended for urethral injection. Acute and chronic febrile diseases, such as scarlet fever, malaria, etc., may produce hæmaturia; in cases of scurvy, purpura, leukæmia, pernicious anæmia, septic infarct, aneurysm, syphilis and parasitic diseases, blood may appear in the urine. Hæmaturia has also been noted in certain conditions outside the urinary tract demanding surgical intervention, such as cholelithiasis and appendicitis. But in spite of this long list of possible causes, hæmaturia is generally due to a lesion somewhere in the urogenital system.

This lesion may be situated anywhere within the genito-urinary tract, from the meatus to the kidney capsule, and while it is true that the cause of the bleeding cannot always be determined even with modern facilities for diagnosis, its source can usually be identified. A suggestion as to the source of the bleeding may often be gleaned by observing whether or not blood appears at the meatus, as its presence here indicates a lesion somewhere anterior to the sphincter muscle. If blood appears at the termination of micturition, it is suggestive, and nearly always diagnostic, of a lesion within the urinary bladder. The presence of blood in the semen suggests a lesion in the seminal vesicles or in the prostate gland. If bleeding follows an attack of renal colic, it suggests a lesion above the bladder.

Ulcerations and neoplasms of the urethra can nearly always be detected by the urethroscope or by palpation; tumors, stones, ulcerations, and diverticula of the urinary bladder can easily be determined by means of the cystoscope and the X-rays. If the source of the bleeding lies above the bladder, ureteral catheterization and roentgenograms will be found to be of the greatest diagnostic aid. It should be borne in mind, however, that the presence of a few red cells in the urine or even a hæmorrhage after catheterization may be due to traumatism by the catheter and thus will not be a true diagnostic index. For this reason ureterograms and pyelograms should be added to establish the diagnosis.

The source of bleeding is best discovered during a hæmorrhage rather than during the interval between attacks.

[1]From the Cleveland Clinic. Presented in the symposium on hæmorrhage before the Clinical Congress of the American College of Surgeons, October 22–26, 1923, Chicago.

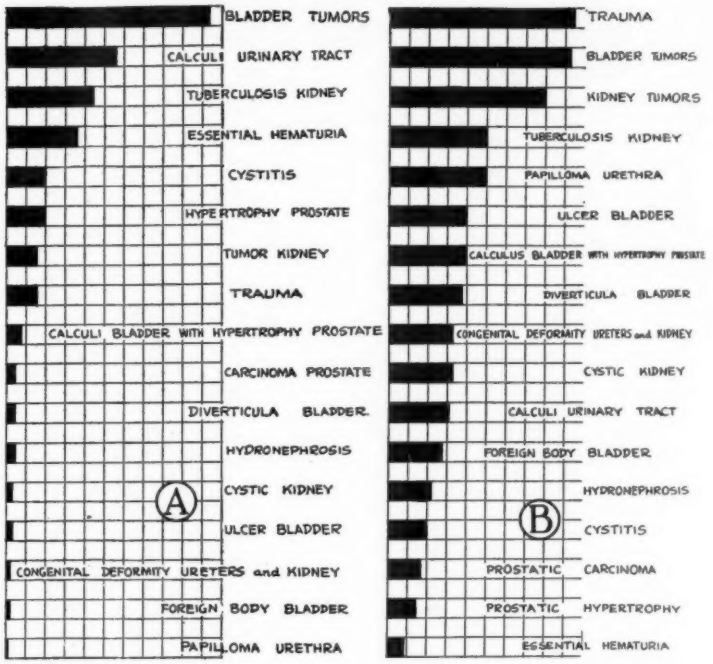

Chart A. The relation of the primary cause to the total incidence of hæmaturia.
Chart B. The relation of the occurrence of hæmaturia to the primary cause.

According to the experience of most urologists, the most common cause of hæmaturia is a growth somewhere in the genito-urinary tract. Three reporters (4, 6, 8) have found new-growths to be the cause of hæmaturia in over 50 per cent of their cases and Hinman (2) in analyzing 709 cases of renal bleeding reported by eight surgeons, found that hæmaturia had been the initial symptom in 301, or 42 per cent, and that it was the only symptom in 14 out of 209 cases, or 6.6 per cent. In this group, Israel reported hæmaturia to have been the initial symptom in 70 per cent of his 66 cases and Braasch reported 83 cases of hypernephroma in 77 per cent of which hæmaturia had been present for a year before other symptoms precipitated treatment. In a series of 100 cases, Chute (1) found 64 per cent due to new-growths, 50 per cent of these being tumors of the bladder.

In general, tumors, tuberculosis, and calculi are found to be the most frequent and important causes of urogenital bleeding, although some consider nephritis as first in importance. Thus, Walther (6) has reported that among 74 cases of hæmaturia, 36, or 51 per cent, were due to tumors, 72 per cent of which were malignant; 13, or 9 per cent, were caused by calculi; 5, or 7 per cent, were due to renal tuberculosis; and in 4 the condition was diagnosed as "essential hæmaturia." Kretschmer (4), in a report of 238 cases of hæmaturia, states that in 14 the source but not the cause of the bleeding was determined, and that in 25 cases the source was not determined. Of the remaining 197 cases, new-growths were responsible for 99 or 50 per cent. Tuberculosis accounted for the bleeding in 33 cases and urinary calculi in 32 cases while in 12 cases the bleeding was due to nephritis.

Hunner (3) believes that stricture is the cause of hæmaturia more often than is realized and that nephritic processes are often due to stricture. He believes that of Israel's

reported 14 cases of essential hæmaturia, 11 were due to stricture. Young (7), of Boston, believes that a pre-nephritic condition may often account for blood in the urine.

In addition to these principal causes it should be added that hæmaturia may be caused by angioma or varicosity of the papillæ, or by vascular distention due to the mechanical rupture of blood vessels resulting from injury caused by some circulating injurious agent.

There is a certain group of cases, in which the bleeding comes from one or both kidneys, in which no pathological condition can be found. These are the cases of so-called "essential hæmaturia." That there must be a cause, however, even though it cannot be found, is quite generally accepted, for certainly if a person has hæmaturia there must be some reason for it.

A study of the case histories in my own series of 2,922 cases of diseases of the urogenital tract shows that hæmaturia was present in 798 or 26 per cent. In 32 per cent the primary cause of the bleeding was a new-growth somewhere in the urogenital tract, in 11 per cent tuberculosis was the cause, and in 16 per cent calculi were present (Chart A). That such figures as these do not, however, give the true significance of hæmaturia as a diagnostic indication is shown by the following figures in which the relation of the presence of hæmaturia to different pathological conditions of this tract is indicated (Chart B). Hæmaturia was present in 93 per cent of our cases of tumors of the bladder; in 80 per cent of the cases of tumors of the kidney, in 50 per cent of the cases of tuberculosis, and in 48 per cent of the cases of calculi. As is shown by the charts, in our series most of the pathological conditions of the genito-urinary tract showed hæmaturia in a greater or less percentage of the cases. Among the cases of trauma, hæmaturia was present in all but two instances.

CONCLUSION

The above considerations emphasize the point that hæmaturia from the urogenital tract may be a symptom of almost any pathological condition within that tract and that therefore the presence of blood in the urine must be considered as an imperative indication for the application of every diagnostic measure at our command to locate the primary source of the bleeding, and that no case should be classified as one of essential hæmaturia until every diagnostic measure has been applied without avail.

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THE RELATION OF BLOOD-COAGULATION TIME TO POSTOPERATIVE HÆMORRHAGE[1]

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THE determination of the clotting time of the blood previous to operative procedures, especially tonsillectomies and adenoidectomies, is now a routine requirement in many hospitals. In spite of this fact, otolaryngologists and general practitioners have varying opinions as to the actual value of the test. Some have implicit faith in the value of the clotting time as a guide to the performance of tonsillectomies, and will hesitate to operate when the coagulation time is in the neighborhood of 7 minutes: others take the extreme opposite viewpoint, as exemplified in the case of one physician, who, when told that his patient had a coagulation time of 20 minutes or over, said: "Fine, send her up in the operating room immediately." Of course, the seriousness of operative procedures in such striking conditions as hæmophilia, chronic jaundice, leukæmia, purpura, etc., are well known and leave very little room for argument. This study, however, does not concern itself with cases of this character. We have attempted to determine what influence the coagulation time exerts upon hæmorrhage in a series of individuals who are apparently normal, with respect to the absence of any striking anæmia, jaundice, acute illness, or any other easily apparent abnormality.

CAUSES OF HÆMORRHAGE

Before entering into a discussion of the results of this work, let us review the causes of hæmorrhage in tonsillectomies. In the first place, there is surprisingly scant statistical data showing the relation of coagulation time to hæmorrhage. Ballenger (1), Phillips (2), and the majority of other authors of standard textbooks on otolaryngology, have very little or nothing to say with regard to this point. Any one who has given any thought to the matter knows of the many and various factors that may cause bleeding in tonsillectomies which have no direct relation at all to the clotting powers of the blood. There may be an abnormal distribution of the blood vessels leading to the tonsil. The operator may inadvertently operate before the acute inflammation of the tonsil has subsided, and thus get hæmorrhage from the increased vascularity. The tonsils may be fibrosed due to recurring tonsillitis or peritonsillar inflammation. Various local causes, such as tuberculosis, malignancy, and syphilis of the tonsils predispose to bleeding. Arteriosclerosis, cardiac disease, especially aortic insufficiency, and hyperthyroidism are generally believed to increase the probabilities of hæmorrhage. The method of operation is generally considered to be an important factor. A number of other conditions, such as age, sex, pregnancy, etc., are claimed by O'Malley (3) to be causative factors in hæmorrhage. A cause of bleeding which is by no means negligible is the skill of the operator. In one hospital, for example, I believe that the clumsy technique of one operator in particular was the cause of the bleeding in a good share of the cases.

Several well recognized conditions may cause serious bleeding because of the faulty clotting powers of the blood. Hæmophilia, of course, is the classical, and at the same time most dreaded, example; its outstanding characteristics being its hereditary tendencies, its occurrence only in males, hereditary transmission only through females, occurrence of spontaneous hæmorrhage, and markedly increased clotting or bleeding time. Jaundice, especially of the chronic type, disturbs the coagulative processes of the blood. In purpura hæmorrhagica, melena neonatorum, necrosis of the liver, phosphorus poisoning, chloroform poisoning, and acute yellow atrophy, there is marked impairment of the clotting powers of the blood. As Dorrance (4) and others have emphasized, in conditions such as pernicious anæmia, splenic anæmia, and leukæmia, there are periods in the disease in

[1] Presented at the Frances Willard Hospital during the Clinical Congress of the American College of Surgeons, Chicago, October, 23-26, 1923.

which the coagulation time is delayed, while at other times it may be normal.

Any one of several factors that constitute the process of clotting may be at fault in defective coagulation. And it is essential to appreciate that and have a working knowledge of the process of blood-clotting and the elements that enter into it if we are to learn successfully to treat or to prevent these hæmorrhages. For instance, in melena neonatorum the cause, and therefore the treatment, of faulty blood coagulation is altogether different from that in obstructive jaundice. In the former there is a deficiency in prothrombin, and injections of blood serum or blood transfusion are therefore beneficial. In the latter, on the other hand, there is a deficiency of calcium, and administration of calcium salts is the proper procedure. The most widely accepted theory of coagulation, that of Howell, in his own words, is as follows:

"In the circulating blood we find as constant constituents fibrinogen, prothrombin, calcium salts, and antithrombin. The last named substance holds the prothrombin in combination and thus prevents its conversion or activation to thrombin. When the blood is shed, the disintegration of the corpuscles (platelets) furnishes material (thromboplastin) which combines with the antithrombin and at the same time liberates more prothrombin; the latter is then activated by the calcium and acts on the fibrinogen."

From these observations we can readily see that abnormal clotting may be due to any of the following causes:

1. Diminished amount of fibrinogen. This is a result of injury to liver cells, as in acute yellow atrophy, chloroform poisoning, phosphorus poisoning, and yellow fever. In many cases of chronic cirrhosis of the liver, as shown by Whipple (5), there is feeble clotting of the blood due to deficiency of fibrinogen. In such cases it is not so much the coagulation time that is altered as the firmness of the clot.

2. Deficiency in prothrombin. This occurs in melena neonatorum. In hæmophilia the fault lies probably in a qualitative change in the prothrombin.

3. Deficiency in calcium.

4. Deficiency in thromboplastin. It is highly questionable if this ever occurs because this element is derived both from blood and tissue cells.

5. Excess of antithrombin. Experimentally this is produced by injections of peptone or hirudin; clinically it is said to be increased in septicæmia, pneumonia, and miliary tuberculosis.

From a practical point of view it is well to remember that so far it has not been shown that normal coagulation time can be decreased by the administration of substances which aim to alter the blood-clotting elements; and consequently, hæmorrhage in an individual with normal coagulation time will not be controlled by horse serum, coagulose, prothrombin, gelatin, etc.

With due regard for the previously mentioned rather infrequent causes of delayed clotting of the blood, there still remains the mass of individuals, who are more or less normal, but who present marked differences in their blood coagulation time. And the question arises, what relation does the clotting time have to postoperative hæmorrhage in such individuals?

PROCEDURE

An attempt was made to answer this question by a study of 500 cases of tonsillectomies and tonsillectomy-adenoidectomies at the Frances Willard Hospital operated on between April 24 and October 6, 1923. There was no selection of cases for this study, all coagulation tests being made on the patients as they presented themselves at the laboratory. The clotting time determinations were done chiefly by me and the remainder were made under my direct supervision. It is, of course, common knowledge that the time of coagulation varies greatly with the methods used; and the methods are legion. However, according to most authors, the method of Brodie and Russel (6), as modified by Boggs, is the most accurate and simple method for clinical purposes. The apparatus consists of a truncated cone of glass projecting into a closed chamber provided with a tube on the side, so arranged that when air is blown into the chamber by means of a rubber bulb it strikes the drop of

blood on the end of the cone at a tangent. The procedure followed was to cleanse the lobe of the ear, pierce it so that the blood appeared with practically no pressure, wipe away the first drop and to use the second drop. The time of appearance of the second drop was accurately noted and the drop was then placed on the truncated cone and inverted into the chamber and placed under the low power lens of the microscope. Coagulation was watched for by gently squeezing the bulb about every 30 seconds. Before clotting sets in the individual corpuscles move freely in a circular direction. When clotting begins the cells move in masses and then they become fixed so that when the air current strikes them they move somewhat but return immediately to their original position. This latter was taken as the end point in all the cases studied.

These cases were followed up as to the occurrence of either operative or postoperative hæmorrhage. It was not the intention of the author to study those cases who have the ordinary slight bleeding, but rather to note only those having serious or profuse hæmorrhage. It is apparent that it is a rather unpractical feat to determine the degree of bleeding by accurate measurements. My criterion for the hæmorrhage under consideration was that degree of bleeding sufficient to be noted by anxiety on the part of the attending physician and which called for active general or local measures. The anæsthesia was nitrous oxide ether anæsthesia in the majority of the cases. It is to be regretted that the operative technique which was used on each case was not recorded.

RESULTS

In this series of 500 cases the range of clotting time was between 1 and 9 minutes. The average clotting time for the entire series of cases was 3 minutes 58 seconds. Of these, 16 or 3.2 per cent, had profuse hæmorrhage, and the average coagulation time of the latter was 4 minutes 23 seconds.

Of the series, 288 cases were under 15 years of age, with an average coagulation time of 3 minutes 56 seconds. Seven of these, or 2.4 per cent, had severe hæmorrhage.

Of the series, 212 were over 15 years of age, with an average coagulation time of 4 minutes 3 seconds. Nine of these, or 4.2 per cent had severe hæmorrhage.

Of the 288 cases under 15 years of age 149 were boys, with an average coagulation time of 3 minutes 55 seconds. Three of these, or 2.0 per cent, had severe hæmorrhage.

Girls under 15 years of age numbered 139, with an average clotting time of 3 minutes 57 seconds. Four of those, or 2.9 per cent, had severe hæmorrhage.

Of 212 individuals over 15 years of age, 73 were males, with an average coagulation time of 4 minutes 15 seconds. Two of these, or 2.7 per cent, had severe hæmorrhage.

Of those over 15 years of age 139 were women, with an average clotting time of 3 minutes 57 seconds. Seven of these, or 5.0 per cent, had severe hæmorrhage.

In this series of 500 cases there were 37 having a coagulation time of 6 minutes or over. Combining these 37 cases with 34 others previous to the series under consideration, we have 71 cases with a coagulation time of 6 minutes or over among whom we can attempt to watch for any increase in tendency to hæmorrhage. Of these 71 cases, only 3, or 4.2 per cent, had severe bleeding.

The results of the above study may be strikingly summarized in the following table:

	Average coagulation time	Profuse hæmorrhage Per cent
Entire series	3 min. 58 sec.	3.2
(With average coagulation time of 4 min. 23 sec.)		
Children	3 min. 56 sec.	2.4
Adults	4 min. 03 sec.	4.2
Boys	3 min. 55 sec.	2.0
Girls	3 min. 57 sec.	2.9
Men	4 min. 15 sec.	2.7
Women	3 min. 57 sec.	5.0

Among 71 cases with coagulation time of 6 minutes or over, 3, or 4.2 per cent had severe hæmorrhage.

SUMMARY AND CONCLUSIONS

In a study of 500 cases of tonsillectomies and adenoidectomies from the standpoint of the relation of the coagulation time of the blood and hæmorrhage, with due consideration for the limitations in the quantity and character of the clinical material encountered, it was found:

1. That the coagulation time is not apparently influenced by such factors as age and sex.

2. That the average coagulation time for cases having profuse hæmorrhage was not much higher than the average for the series.

3. That in a series of 71 cases with a coagulation time of 6 minutes or over the frequency of hæmorrhage was very little higher than that for the series of 500 cases.

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MULTIPLE SKELETAL METASTASES FROM CANCER OF THE BREAST

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MULTIPLE rarefying central lesions in bone having a roentgenological appearance of expanding neoplasms tempt one to make a diagnosis of multiple myeloma. Metastatic cancerous deposits may give identical roentgenograms and before the diagnosis of multiple myeloma can be established, most careful examination must be made to eliminate any possible focus of carcinoma. The case here presented appears worthy of record because of the chronicity and enormous number of the bony deposits and the comparative insignificance of the primary cancerous tumor and late development of other metastatic foci. By good fortune it was possible to obtain accurate records of the patient for a period of one year before her death, and as the body became the property of the Medical School, complete dissection could be made.

Through the courtesy of Dr. Dalton Richardson, of Austin, Texas, the early findings and X-ray pictures were available. The history as recorded below, was obtained from the patient, 4 months before her death and the diagnosis at this time was much less difficult than in the early months of her illness. Indeed, when she first applied for medical attention, her skeletal lesions so completely dominated the clinical picture that there seemed no doubt that they were primary, i.e., multiple myeloma.

On May 28, 1921, 13 months before the patient's death, she applied to Dr. C. H. Brownlee at the City Hospital in Austin, Texas, for treatment for fracture of the humerus. She gave the history that 2 weeks previously, while attending a revival meeting she threw up her arm and felt it break near the shoulder. The arm was bandaged by a negro doctor but did not appear to her to be healing well. Dr. Brownlee realized that there was some pathological condition in addition to the fracture as the patient had evidence of tumors in both upper arms. She was sent for roentgenological examination to Dr. Richardson. Tumors of the upper part of the shafts of both humeri were discovered and Dr. Richardson made X-rays of the rest of the skeleton. In addition to the large masses in the humerus, several nodules were visible in the ribs, in the scapulæ, in the right femur, and in the pelvis. In the right humerus an imperfect bony shell surrounded the rarefied tumor area. In the left humerus, the bone shell was much less distinct. The other tumors which were recognizable at this time showed no bone shell but had the appearance of more or less circumscribed rarefactions. This is particularly well shown in the case of the neck of the left femur and the two iliac bones.

In examining the patient, an enlargement of the left breast was found, but the patient insisted that this had been present since she was 10 years of age and that it was due to the traumatism of carrying a bag of cotton slung over the left shoulder. The long duration of the breast tumor and the youth of the patient, as she was then but 28 years of age, seemed to rule out the diagnosis of malignant disease of this breast. Ulceration was not present at this time, but occurred shortly after the patient's admission to the hospital. The entire breast was enlarged and had rather the appearance of fibroid mastitis. When ulceration did occur, it was attributed to growth coming from a rib below, and while the early X-ray had shown no tumor in this particular situation, it was supposed that a new lesion had developed here. It has to be noted that at this time, there was no evidence of glandular involvement. The X-ray plates were presented by Dr. Richardson at the December, 1922, Meeting of the North American Radiological Association. By this time, the diagnosis of metastatic carcinoma had been established, but the majority of the radiologists present, who were unacquainted with the pathological findings, were inclined on the basis of the roentgenograms alone, to consider the case one of multiple myeloma.

Fig. 1. Roentgenogram of left h merus, taken 2 weeks after spontaneous fracture, 13 months before death. Figures 2, 3, and were taken at the same time as Fig. 1.

Fig. 3. Thorax, showing lesions in the ribs, not very numerous nor large at this time.

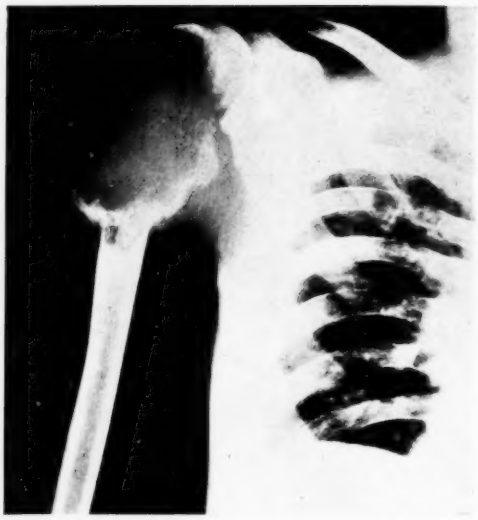

Fig. 2. Right humerus, showing bone shell formation about the tumor.

The history and physical examination of the breast, when the patient first applied for treatment did not suggest carcinoma. Nine months later, after the ulceration of the breast had appeared, there was no doubt that the breast was malignant; even at this late date, however, there were no palpable axillary deposits, and the supposition that the tumor was an extension from the underlying ribs seemed well founded. In view of the unusual interest of the case, Dr. Brownlee arranged to have the patient transferred to Galveston in order that students of the Medical Department of the University of Texas might see the case.

HISTORY

J. L., age 28, female, negro, of Austin, Texas, was admitted to the Austin City Hospital, May 28, 1921, and transferred to the John Sealy Hospital, Galveston, February 27, 1922. Died, June 19, 1922. The mother died when patient was an infant. The father is living and well. Three brothers and one sister are living and well. One brother was killed in the war. The family history is negative for cancer and tuberculosis.

Previous history. Patient had measles in childhood; influenza about 2 years ago. One year ago she had chills and fever. She had been married twice. By her first husband she had two children, one 10 years and one 9 years of age. She had been married to the second husband 3 years and had not been

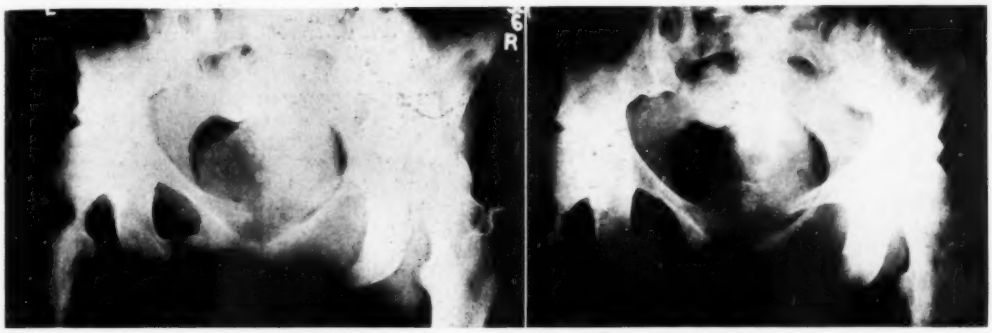

Fig. 4. A. and B. Multiple tumors in the pelvis; one tumor in neck of left femur. Note the absence of any condensation or osteoblastic reaction surrounding the lesions. Many of the tumors here shown remained practically stationary in size until the patient's death, 13 months later.

pregnant in that time. Four or 5 years ago she began having a yellowish vaginal discharge which was rather profuse and somewhat irritating. This discharge was now constant but she had not menstruated since last May, 10 months ago. Before that time her periods had been regular. She had been troubled with constipation practically all her life. She had drunk as much as one-half glass of whiskey and a bottle of beer a day; she preferred a high protein diet. For some time she said her stomach "filled up quickly" and felt uncomfortable. She took but a small quantity of food and regurgitated most of that at intervals, without any effort or retching. She formerly weighed 188 pounds, but had been losing flesh for many years and now weighed about 100 pounds.

Present illness. Patient states that she has had a small lump in her left breast since she was about 10 years of age. It was as large as a quail's egg when she first noticed it, and remained stationary in size until about 2 years ago. At that time she began to suffer with pain of a dull, aching character in both flanks and around the umbilicus. She described this pain as traveling over the abdomen in a path that corresponded fairly well to the position of the large intestine. She has had periods of relief from the abdominal pain, but it has continued at intervals to the present date. At about the time that the abdominal trouble started she noticed that when she tried to pick cotton her back seemed "about to break" at a point about 1 inch above the iliac crests. The pain in the back was so sharp that she would have to stop and rest for a time. At this same period of her illness the patient noticed that the lump in her left breast was increasing in size. This she attributed to the fact that in picking cotton she carried the bag across her shoulder and caused pressure on the left breast. Both her children nursed almost entirely from her right breast. She states that the breast has been gradually increasing in size for the last year or two, but has never been painful. She states that the lump in her breast was entirely in the outer and upper quadrant, but about 9 months ago the skin over the lump broke through and after that the lump seemed to move toward the middle of the body. The breast is not painful now unless it is lifted over the ulcerated area. Early in May, 1921, while shouting at a revival meeting she threw up her left arm suddenly and felt it break. A colored doctor bandaged the arm. It began to heal in a faulty position, so she applied to the Austin City Hospital for treatment. She states that for some time before the accident, she had very little use of her arm. Patient did not remember when her shoulders began to swell; she attributed the swelling of the left arm to the injury and did not notice the increase in size of the right shoulder.

Physical examination. February, 1922. Patient is greatly emaciated, this condition being more apparent in the body than in the face. The patient lies quietly in bed on her back with the left thigh drawn up. She seems quite comfortable, and does not look seriously ill. She looks fairly bright, though she often becomes confused in giving her history and occasionally gives impossible answers to questions. When asked to turn in bed she complains bitterly of pain in the back which appears localized at a point in the vertebral column just above a line joining the iliac crests.

The skin is dry and harsh and shows evidence of long-continued neglect. The mucous membranes are pale. Blood examination, March 6, 1922: 3,353,000 red cells, 50 per cent hæmoglobin, 8,480 white cells, normal differential.

The muscles over the body are atrophied from disuse. This is particularly noticeable in the arms.

The eyes are normal. The ears are well shaped, no discharge, good hearing. The nose is normal. The tongue has a thin, whitish coat and is pale in color. The teeth are all present and show no decay, but some sordes. The tonsils are somewhat reddened. The thyroid gland is normal in size.

Examination of the chest shows great emaciation, and the intercostal spaces are depressed. The left breast is three or four times larger than the right, which is small and flabby. The left breast is hard

Fig. 5. Photograph of left breast. Darker areas are carcinomatous; note the extreme degree of fibroid mastitis. The wrinkling of the surface is due to the escape of œdematous fluid when the organ was cut.

and brawny, the skin is shiny, and in the upper left quadrant shows pig-skin dimpling. The nipple appears retracted, because of the œdema surrounding it. Between the overhanging breast and the chest wall is a bleeding ulcer covering an area about 1 inch long. The breast tissue is adherent to the chest wall on the medial side. The axillary glands are not palpably enlarged, at this time.

The lungs are negative. The blood pressure is 122–82, the radial pulses equal and synchronous; the heart rapid but regular, with no murmurs.

The abdomen is scaphoid in shape, shows no fat, and the skin is wrinkled. Aortic pulsations are easily perceived. There is tenderness on deep pressure in the midline below the umbilicus, and in the right iliac fossa; no muscular rigidity.

The uterus and adnexa are apparently normal except for a profuse cervical discharge. Urine examination is negative. Bence Jones protein test is negative.

Deep pressure over the heads of both femora elicits some pain. Movement of the left thigh is restricted; patient keeps this thigh flexed on the abdomen and adducted. No tumors are palpable. Otherwise the lower limbs are negative. The bones of the upper limbs are easily palpated because of the extreme emaciation. Both humeri present tumors about the size of small grape-fruit. The left shoulder joint is intact, but just below this the humerus is expanded by a tumor. There is no pain in the tumor and no tenderness on pressure over it. The round swelling of the left arm begins lower down than that of the right. Below the shoulder joint there is a palpable extent of humerus along the surgical neck that is normal in size. Below this is a swelling of the humerus about the same size as that described for the right arm. Considerable deformity has been produced by the fracture 9 months ago, the carrying angle being increased and medial rotation practically lost. There has been some union, for the patient can use the arm fairly well and suffers no pain. The forearms and hands are normal.

There is marked scoliosis in the lower dorsal and lumbar regions. About one inch above the iliac crests, the spines are very prominent. The patient complains of pain in this situation, especially on deep pressure or on movement of the body. The sacrum is clearly palpable due to the emaciation; it appears normal.

Sensations appear to be normal. Knee reflexes are absent or sluggish as patient lies in bed. Complete neurological examination could not be made on account of the weakened physical condition and lowered mentality of the patient. Pupils equal and react normally.

Treatment. With a view to removing the painful ulcerated tumor of the breast, obviously malignant, and of establishing the diagnosis of the bone lesions, the patient was operated upon March 3, 1922, by Dr. James E. Thompson. General ether anæsthesia was used. An incision was made anteriorly over the tumor of the left arm in the interval between the deltoid and the pectoralis major, avoiding the cephalic vein. The tumor was exposed, the enveloping shell of bone broken through, and a small portion of tissue removed for diagnosis. A large amount of blood was found within the shell of bone, and also a rather hard tumor mass, a small piece of which was curetted with a piece of bone attached. The wound was closed without drainage.

The left breast was removed partly by the knife and partly by cautery. No attempt was made to clean out the axilla or infraclavicular areas because of the possibility that the bone tumors were metastatic from the breast, and the futility of a complete breast operation in the face of so much pathology elsewhere. The wound was closed without drainage.

Postoperative history. The wound on the arm healed by first intention. The breast wound opened at the point of greatest tension on the chest and granulation in this region was very slow; eventually, however, it healed entirely. The left axillary glands enlarged rather rapidly shortly after the operation. On April 6, the interne noticed a rather marked change in the mentality of the patient. She became indifferent to pain and lay in a semi-stupor. From this time until her death on June 19, 1922, there was progressive weakness and emaciation. Two weeks before her death an examination of the lungs was made in the course of a routine ward round but nothing was found. Enlargement of the liver was noted at this time. No systematic neurological examination was ever made nor was the patient's condition such that it could have been satisfactorily conducted.

PATHOLOGICAL REPORT

Biopsy. March, 1922. Left breast, which was excised March 3, is enlarged, intensely fibrosed, with small scattered cysts; the whole organ is greatly increased in size by œdema. In the lower outer quadrant are two solid masses of carcinoma, separated from one another by fibrous breast tissue. These are respectively 2.5 centimeters and 4.0 centimeters in

Fig. 6. Photomicrograph of the outskirts of the breast tumor. Here the epithelial origin of the growth is easily seen. Toward the center the tumor becomes much less fibrous and has an appearance identical with Fig. 7.

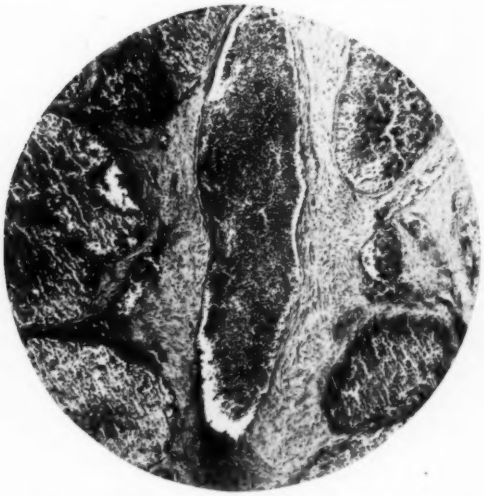

Fig. 7. Tissue removed for diagnosis from left humerus where the tumor mass measured 6 by 8 centimeters. The structure is that of medullary carcinoma, identical with the interior of the breast tumors.

diameter, and the larger, which is in the pendulous portion of the breast, has ulcerated through the skin giving rise to a depressed sinus. Microscopically the nodules show a cell mass type of medullary carcinoma, with a great amount of fibrous tissue on the outskirts of the tumor. The tissue of the remainder of the organ shows precancerous proliferation of the duct epithelium, dense fibrous tissue, œdema, and slight round cell infiltration. The tissue removed from the humerus shows the same microscopic picture as the cellular central portion of the breast nodules.

Pathological diagnosis. Carcinoma arising in chronic fibroid mastitis; secondary deposit in bone.

Autopsy protocol. Death occurred June 19, 1922; the body was embalmed on the same day. Examination of the thoracic and abdominal organs was made June 28, by Dr. Henry Hartman. Further examination involving the dissection of the entire body was made by Dr. V. H. Keiller. The following report summarizes the complete findings:

External appearance. The body presents the appearance of extreme emaciation. The legs are drawn up, bed sores are present on sacrum and over right trochanter and external malleolus. The scar on the left chest from breast amputation has healed, and there is no external evidence of recurrence except adherence to the chest wall. On reflecting the musculocutaneous flap on this side for the exposure of the ribs, the scar was found to be adherent to one or two cancerous nodules on the underlying ribs. The right breast is rather large, freely movable, and intensely fibrosed. Small cysts show in the fibrous tissue. Except for the lack of œdema this breast is similar to the non-cancerous areas of the left breast. Microscopically it shows fibroid mastitis.

The *heart* and *pericardium* are normal. The aorta shows slight atheroma.

Lungs and pleura. The pleural cavities contain about 300 cubic centimeters of blood stained fluid. The parietal pleura is normal except for a few scattered nodules on the right side of the diaphragm, to which a portion of the lung is adherent. Both lungs contain many white, scattered, cancerous nodules, varying in size from a pin head to a pea or slightly larger. These are more numerous in the apices and in the middle lobe of the right lung than elsewhere. The visceral pleura shows similar nodules, especially along the sharp lower margins of the lobes, where the small deposits give a fringed appearance. Small areas of consolidation surround all the nodules, but the lungs as a whole crepitate and float in water.

Genito-urinary system. The kidneys, ureters, and bladder are normal. Microscopic section shows slight cloudy swelling and congestion of renal parenchyma. The uterus and adnexa are normal, with no evidence of old tubal infection.

Gastro-intestinal system. The stomach, intestines, and pancreas are normal. The liver is somewhat larger than normal, the surface deep red with no evidence of fatty infiltration, no mottling. Scattered over the entire surface and throughout the interior of the organ are white, cancerous nodules varying from 1 centimeter to 4 centimeters in diameter. On the surface many are umbilicated. The largest deposit is found around the longitudinal fissure and

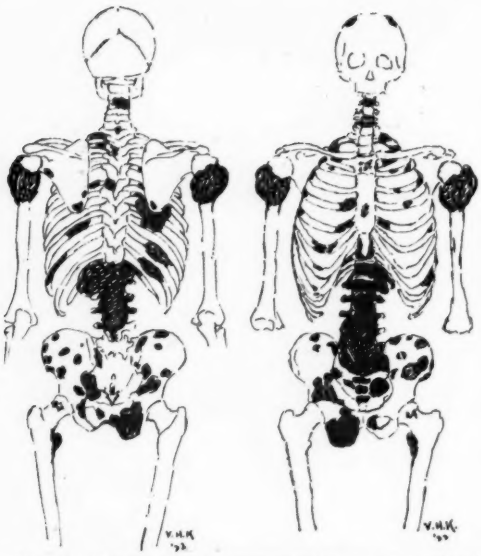

Fig. 8. Diagrammatic representation of the skeletal tumors as found at autopsy. This is intended to portray the lesions graphically rather than with extreme accuracy. Some of the small vertebral lesions have been omitted. The lesions represented as occupying the costal cartilages should be in the bone at the costochrondral junction.

the attachment of the falciform ligament. This and the fact that there are nodules along the falciform ligament suggest that growth has been carried by direct extension from the retrosternal tissues. The gall bladder is normal.

Ductless glands. The suprarenal capsules and the thyroid gland are normal. The hypophysis is rather small. The infundibulum ends in a sac-like dilatation which leaves a rather large pit in the posterior lobe. There is no evidence of a pathological condition.

Hæmatopoietic system. The spleen is slightly enlarged, the capsule thin, the cut surface deep red, with prominent malpighian corpuscles. An accessory spleen 3 centimeters in diameter is present near the hilus. No cancerous deposits appear in either the spleen or its accessory. Microscopic examination shows congestion and lymphoid hyperplasia only.

Lymph nodes. All the lymph nodes of the body were examined with great care. Except in the cases in which the metastatic deposits were present, they were extremely small, probably as a result of the general depletion. In no instance is the cancerous deposit in the nodes of great size. The largest metastases are those of the left axilla, and even here the glands are discrete and remains of lymphatic tissue are still present around the cancerous focus. Deposits in the lymphatic system were found in the following situations:

One left iliac node;

One pre-aortic node just below the diaphragm;

One or two anterior diaphragmatic nodes;

Bronchial nodes on both sides formed masses the size of an English walnut, composed of discrete glands containing small deposits;

One retrosternal (internal mammary) node at the level of the third intercostal space on the left side was about 1 centimeter in diameter;

Left axillary, infraclavicular and supraclavicular nodes. The external and subscapular group of the left axillaries form a mass of discrete nodes which together are 6 by 4 centimeters wide; the central and pectoral groups show practically no enlargement. The interpectoral could not be identified. The infraclavicular group consisted of two rather large nodes with cancerous deposits; the supraclavicular, two or three small nodes of solid carcinoma;

One pretracheal gland on the left side;

Right axillary and infraclavicular group. The axillary mass is half the size of the left, otherwise similar. The right supraclavicular nodes are also affected. No interpectoral was found on this side.

It appears from the groups affected and the bilateral character of the axillary involvement that the deposits to these nodes probably came by way of the humeral tumors rather than directly from the breast cancer. No other cancerous lymph nodes were found in a most painstaking dissection of all lymphatic tissue.

Nervous system. The meninges are normal. The cerebellum contains a tumor 3 centimeters by 5 centimeters, occupying the lower portion of the right lateral hemisphere. This has caused some distortion of the cerebellum and some herniation into the right side of the foramen magnum. The tumor involves the entire thickness of the arbor vitæ; the central core of white matter in the vicinity is œdematous. The corpus dentatum is not encroached upon. The cut section shows some fatty cysts in its interior, similar to those frequently found in breast cancer; the bulk of the tumor is solid like the deposits elsewhere in the body.

Except for a slight increase in the size of the lateral ventricles, the remainder of the brain is normal.

The spinal cord is normal, grossly, but microscopically it shows posterior sclerosis of the anæmic type.

The peripheral nerves, both cranial and spinal, are normal, except that those of the left side of the lumbosacral plexus are distorted by the tumor of the vertebræ of this region. No nerves are directly involved in the tumor masses.

Skeletal system. The greatest interest in the case centers about the skeletal deposits, many of which were found clinically. Even the X-ray pictures, however, did not reveal the enormous number of small foci present; though this was in part due to the time between the latest roentgenological examination, February, 1922, and the death of the patient in June.

One small nodule, 2 centimeters across, occurred in each parietal bone of the *skull* with no projection into the cranial cavity.

With the exception of four of the cervical *vertebræ* and the coccygeal all the vertebræ contained one or more cancerous deposits. The extent of the involvement follows:

Cervical vertebræ: fourth—body, inferior articular process, lamina and spine, two foci; sixth—body entirely destroyed, contour preserved; seventh—body entirely destroyed, contour preserved, left lamina and spine, two foci.

Thoracic vertebræ: first—right transverse process; second—spinous process; third—three small discrete foci in body; fourth—whole body; eighth to twelfth—all bodies are completely destroyed but remnants of the intervertebral discs remain so that the outlines of the separate vertebræ are preserved. The laminæ and spinous processes are also involved but have preserved their outline to a considerable extent. The right pedicle of the eleventh is affected and the left pedicle of the twelfth is involved in a deposit, which merges with one in the twelfth rib.

Lumbar vertebræ: All the lumbar bodies, pedicles, laminæ, and spinous processes are involved in a practically solid mass of carcinoma in which the individual vertebræ are fused. The three lower transverse processes on the right side and the two lower on the left emerge from the mass. There is a marked lateral curvature in this region.

Sacral vertebræ: First and second—bodies are destroyed by bulging growth; third—body contains small deposit, both alæ contain small deposits; third and fourth—a large mass springs from the left transverse processes, partially closing the great sciatic notch; fourth and fifth—bodies contain small masses and both sacro-iliac articulations are affected.

The *sternum* shows scattered nodules in the manubrium and one fairly large deposit opposite the fifth interspace.

Examination of the *ribs* shows, on the right side: first—two large deposits; second—two large deposits; third—one deposit; fourth and fifth—two each, one near angle and one at costochondral junction; sixth—three deposits; seventh—two deposits; eighth and ninth—large fused mass at the angles with small nodules anteriorly; tenth and eleventh—one large mass in each, not fused; twelfth—no deposit. On the left: first—all involved; second—one large mass at angle, two small deposits; third—two small deposits; fourth—one small deposit; fifth—two small deposits; sixth and seventh—a small deposit in each; eighth—one very large mass at angle; ninth—one large and two small deposits; tenth—one small deposit; eleventh—no deposit; twelfth—large mass blending with that involving the transverse process of the first lumbar vertebra.

It should be especially noted that despite the tremendous enlargement of the lumbar vertebræ and extensive involvement of the whole spinal column, no narrowing nor deformity of the lumen of the vertebral canal is present at any point, nor is the dura mater involved.

Examination of the *pelvic girdle* shows that the left ilium contains twelve to fourteen separate deposits of varying size. The right ilium contains eight or ten. The left ischium contains four deposits. The left pubis contains one large deposit. The rami of the right pubis and the ramus of the right ischium are fused in one large mass which completely obliterates the obturator foramen.

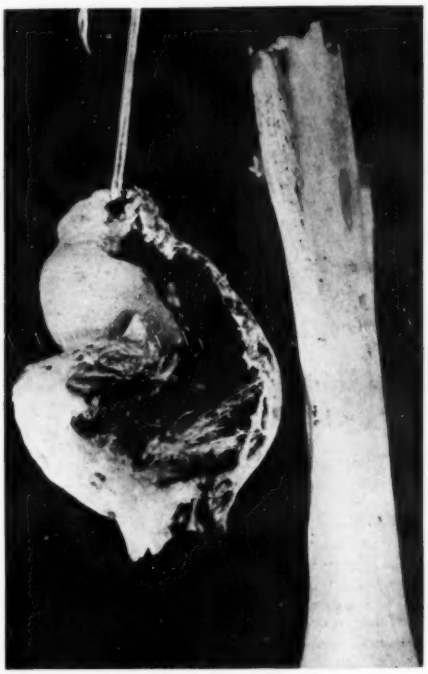

Fig. 9. Macerated specimen of the right humerus. This is the only lesion in which shell of new bone was well formed.

In *left femur* one mass involves the lesser trochanter and small area below and above this. The marrow of the upper one-third of the shaft of this bone is gelatinous like that to be described in the humeri; that in the lower two-thirds is normal fatty marrow. Except in this bone and the two humeri the marrow is entirely normal in all the bones examined.

Right femur and the leg and foot bones on each side were normal. All joints normal.

Examination of the *shoulder girdle* shows both clavicles normal. The right scapula shows one deposit near the inferior angle. The left scapula has two deposits near the inferior angle and one just below the glenoid cavity.

The upper ends of the shafts of both *humeri* are involved in large deposits. On the left the mass measures 6 by 8 centimeters; the bone shell is practically destroyed; spontaneous fracture has occurred through the tumor. From this deposit a specimen was taken for the biopsy in March. On the right side

Fig. 10. Anterior view of the skeleton. The rib fractures occurred in the course of preparation.

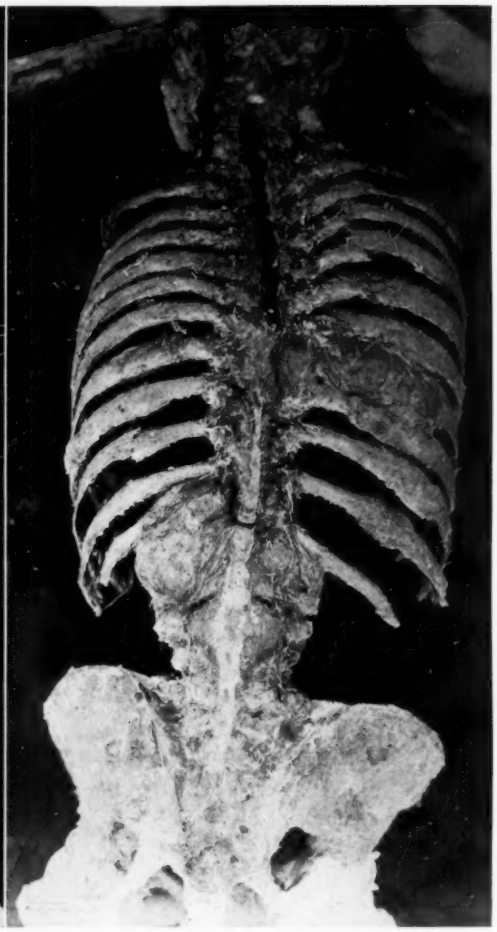

Fig. 11. Posterior view of the skeleton. The large lumbar tumor is well shown.

the tumor is slightly smaller, the head distorted by old fracture, the bony shell fairly well preserved. This specimen was macerated and photographed. Below the lesions the marrow cavities are filled with reddish, gelatinous marrow, practically acellular on microscopic examination.

The bones of the arms and forearms are normal; so also is the marrow in those examined for this point.

The *muscular system* is not affected except by pressure where the skeletal tumors are of large size. There is no tendency on the part of any of the tumors to invade muscle except by contiguity.

Some of the deposits in the skeleton are of long duration as is evident from clinical history and size; others are of recent origin. The enormous number of these deposits suggests an early blood stream generalization; but the spleen and kidneys escaped and the lungs show only very recent deposits, certainly only a few weeks old. Microscopically all the tumors are the same; having small rounded epithelial cells, little fibrous tissue, and no variation in the size and shape of the malignant elements. Cystic changes are seen in the cerebellar deposits only. In most of the tumors there is no fibrous reaction; one (in the right scapula) showed dense fibrosis and some limiting bone formation. The right humerus also showed well developed bone shell. There is no evidence of syphilis or of other pathological condition.

DISCUSSION

Before entering into a discussion of the peculiar clinical and pathological features of the case, it may be well to summarize the important points in the progress of the disease. From the age of ten, the patient had had a lump in the left breast (fibroid mastitis of traumatic origin). This she stated very definitely, and there seems no reasonable doubt that the statement is correct. After remaining quiescent for 17 years, the lump began to take on a malignant character. At the same time evidences of malignant disease of the lumbar spine appeared in the form of pain and weakness in the back. This was so important to the patient that the painless growth in the breast attracted no attention. Over one year later spontaneous fracture of the humerus called attention to the presence of large humeral tumors, which had evidently been present for some months. The breast tumor even at this time was so comparatively insignificant that it attracted but little attention from the medical attendants. Many skeletal deposits were demonstrated by X-ray at this time, but there were no chest nor abdominal metastases and *no lymphatic enlargements*. Nine months later when the breast tumor was removed and biopsy performed on the arm, there was no evidence of metastasis to other organs nor to lymph nodes and the primary growth in the breast, consisting of two tumor masses separated by an area of fibrous mastitis was smaller than one of the humeral tumors. Moreover recurrence did not make its appearance in the skin; though at the autopsy nodules were found in the ribs below the breast scar. Probably the cerebellar lesion was the next to develop after the skeletal deposits, as the patient's lethargy 3 months before death seems to indicate increased intracranial pressure. Lymphatic node involvement did not occur until 3½ months before death. It was then recognized by the palpation of a small nodule in the left axilla. At the time of death, the whole mass of all cancerous nodes in the body, did not equal in size the larger (left) humeral tumor. Liver involvement was late (as shown by its size) but rapidly spreading; the lung metastasis was extremely late. The spleen and kidneys were never affected.

One is at once impressed with the peculiar selectivity of the lesions. Direct extension of growth to neighboring lymph nodes, generalized lymphatic or blood stream involvement, or distant haphazard secondary deposits from emboli in the circulation, are readily understood. In this patient at a very early stage in the disease, numerous foci appeared in practically all the bones of the trunk, and in the humeri and in one femur. Sampson Handley expressed the belief that the skeletal deposits in cases of cancer of the breast were due to lymph drainage above fascial planes. He considered that the usual absence of growths below the elbows and below the knees were explained by this. It appears reasonable to suppose that growth through lymph channels to bones would give rise within the time allowed, 2 years, to lymphatic tumors which would clearly demonstrate the route of infection. The palpation of the axillary nodes in an emaciated subject is comparatively easy. No enlargement of these nodes was demonstrable in this case until many months after the development of the humeral masses. The lumbar vertebræ contained the largest mass in the body. Between it and the primary tumor, the affected glands, which were one preaortic, one or two anterior diaphragmatic, and two small masses of bronchial nodes, still retained their characteristic anatomical features, probably indicating recent involvement. It appears much more probable that the lymphatic followed the osseous deposits. These osseous deposits, so early and so numerous, appear to have been disseminated by the blood stream. One can only suppose some inherent difference in tissue resistance permitted growth here, while inhibiting it in other organs.

One other feature of the case requires special mention. The gross appearance of the bone lesions as exposed at autopsy was typically that of carcinoma. Microscopically also, where a sufficient portion of growth could be studied, the characteristic arrangement of medullary carcinoma was readily perceived. The cancerous character of the humeral tissue was obvious. Had the breast tissue not been available, the histologist expecting a primary bone lesion might have been led to the suggestion of "alveolar round cell sarcoma."

SOME PHASES OF THE PATHOLOGY OF THE APPENDICES EPIPLOICÆ

With a Report of Four Cases and a Review of the Literature[1]

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In the past few months we have encountered two instances in which the appendices epiploicæ have been the cause of acute abdominal conditions necessitating immediate operative interference, and an equal number in which the pathological states of the appendices were associated with other intra-abdominal lesions for which operations were primarily undertaken. The first of these proved to be the presence of a completely twisted and gangrenous appendix epiploica in the sac of what appeared to be, clinically, a strangulated left inguinal hernia. In the second case a like structure was found strangulated in the neck of a left femoral hernia. The other two instances were twisted, acutely inflamed appendices epiploicæ encountered accidentally, in the one case in the performance of an appendicectomy for an acute gangrenous appendix vermiformis; in the other, in the performance of an autopsy in which death was caused by an acute hæmorrhagic pancreatitis. These have proven, in a search of the literature, to be only some of the phases of a variety of lesions which may have their inception in these processes. Pathological states of the appendices epiploicæ furnish a particularly interesting chapter in the emergencies of abdominal surgery because of the rarity of these conditions and the difficulties in diagnosis to which they give rise. It is for this reason that I believe the subject to be of sufficient interest to place these cases upon record, to discuss briefly some of the phases of the anatomy, physiology, and pathology of these organs and to review the literature which has grown up about them.[2]

ANATOMY AND PHYSIOLOGY

Appendices epiploicæ are "localized pedunculated overgrowths of subserous fat directly continuous with the fat in the layers of the mesentery." (Bland-Sutton, 3.) They are formed by a reduplication of the peritoneum which enmeshes a variable amount of fatty tissue between its two layers, and consist of small processes or pouches which are confined to the large intestine; none appear on the rectum.

They have been variously designated by different authors. Robinson (34), from whose excellent monograph on the subject I quote freely, calls them sero-appendices to indicate that they bear an intimate relationship to their peritoneal investment. Some have termed them fatty fringes or adipose appendages; others "appendices épiploïques" (Meckel, 22); "appareil séro-grassieux" (Poirier, 32), which appears to be the most composite term yet applied to them.

The appendices epiploicæ are not universally present in vertebrates. Dogs, cats, and rabbits have only rudimentary structures corresponding to the appendices of man. They are entirely absent in cows and sheep, but are well developed in anthropoid apes (Robinson, 34). Authors disagree as to the time when they first appear in the human body. Meckel (22) states that they are found at the fifth month of intra-uterine life; Sappey (35) and Testut (40) that they are unable to find even a trace of these structures in the fetus or in infants. Robinson (34) says that he has always been able to find them in the newborn; particularly in the pelvic colon where they first make their appearance.

The number of appendices epiploicæ present may vary within wide limits, but in round numbers an adult usually possesses about one hundred. While the appendices are arranged along the whole course of the large intestine they are most numerous in the transverse and pelvic colon. The cæcum as well as the vermiform appendix may give origin to

[2] For a complete bibliography with an abstract of the case histories reported in the literature, see article by V. C. Hunt, published in Ann. Surg., 1919, lxix, 31–46.

[1] From the Surgical service of Dr. A. V. Moschcowitz, Mount Sinai Hospital, New York.

them. They are absent from the rectum. To describe accurately their line of attachment to the large intestine, one must recall that the longitudinal musculature of the entire colon is grouped into three bands or tæniæ one situated anteriorly; the others postero-internally and postero-externally. In the transverse colon the anterior band becomes the superior, often called the tænia omentalis; the postero-internal, the posterosuperior or tænia mesocolica; and the postero-external, the inferior or tænia libera. The appendices, as a rule, are arranged in two rows; one in relation to the anterior muscular band, the other to the postero-internal. In some individuals there is only one row present whereas in others three have been observed.

The appendices epiploicæ have no definite form. They may be conical, rounded, or sacculated, with a free dentated border; or cylindrical with more or less of a fringed border and lobulated. Most of the descriptions simply classify them as of irregular form. In general, they are either leaf-shaped with accompanying folds corresponding to their vascular supply, or conical. They vary greatly in length and width. Their size varies with the habitus and state of nutrition of the individual. The conical ones are usually the longest and measure on the average 10 by 3 centimeters. Their weight too is not constant and has been found to vary between 25 centigrams and 1 gram. The combined weight of the appendices is only one fourth that of the great omentum (Robinson, 34).

Histologically, in addition to their serous covering and fatty content, the appendices show a variable amount of reticular and elastic tissue and a few small blood vessels. The two layers of peritoneum comprising the basic structure of the appendices are separable and the potential sacs can be artificially distended with a fluid or air. It has been estimated that their capacity varies from 1 to 2 cubic centimeters. This distensibility is directly dependent upon their size. This phenomenon can be observed in pathological states.

The blood supply of the appendices epiploicæ is derived from branches of the superior and inferior mesenteric arteries which enter at the bases and extend to the extremity of these structures (Hunt, 12). The veins follow the same course as the arteries and empty into the superior and inferior mesenteric trunks. Information concerning the lymphatic supply is lacking.

The appendices epiploicæ are in close relation to the segments of the large intestine from which they arise and the corresponding portions of the mesentery. Their intimate relationship to the three major lower abdominal apertures, the umbilical, femoral, and internal inguinal rings is of clinical importance.

It seems probable that the appendices epiploicæ are in some manner related in function to that of the great omentum because of their similarity in structure. The sum and substance of our knowledge, in spite of a large amount of experimental work upon this subject, seems to relegate the omentum to a protective or absorptive capacity. That the appendices epiploicæ may act in a like manner was recently called to my attention by two illustrative cases. In one an appendix epiploica was found adherent to and wound around a perforating appendix vermiformis in much the same manner that we often observe in the great omentum in these cases. Robinson (34), nevertheless, has demonstrated experimentally that the introduction of fluids into the large intestine causes a rythmic to-and-fro motion of the appendices and deduces that they are in some manner related to the absorption of fluids from this portion of the gut. While this view has not been substantiated, it seems likely that the appendices, which are strictly limited to that portion of the gastro-intestinal tract the main function of which is the absorption of water, may have the power to aid in this as well as in forming a protective barrier against the spread of intra-abdominal infection.

PATHOLOGY

The lesions incident to the appendices epiploicæ can be divided into the following groups:

1. *Mechanical interference* with the blood supply by direct pressure or torsion: (a) within the abdominal cavity or in a hernial

sac; (b) formation of foreign bodies within the peritoneal cavity or in a hernial sac as a result of interference with their blood supply; (c) torsion associated with and secondary to other inflammatory lesions of the abdominal cavity.

2. *Infection of the appendices epiploicæ* incident to or associated with interference with blood supply or to lesions of the corresponding segment of bowel wall (diverticulitis).

3. *Adhesions of the appendices epiploicæ* causing intestinal obstruction.

Within the abdominal cavity torsion is perhaps the only lesion which may compromise the blood supply to these organs. Attached as they are by narrow pedicles along the whole of the colon it is easily understandable that the same factors producing torsion of other abdominal viscera, such as ovary, omentum, intestines, etc., may result in a similar condition in the appendices epiploicæ. The exact mechanism, however, is still unknown. Whether we believe with Morestin (24) that torsion only occurs in excessively long or large appendages or with Payr (30), that a disproportion between the artery and vein may be a determining factor; suffice it to say that no unchallenged theory has as yet been proposed for those cases originating in the abdomen. That intra-abdominal adhesions to an appendix epiploica, as the result of a previous inflammatory process, may result in torsion has been brought to the fore by the case reported by Zoeppritz (47), where an omental adhesion was found attached to the extremity of a twisted appendix epiploica. But in this case it is barely possible that the adhesion was secondary to the torsion and not primarily a causative factor.

That torsion of the appendices may occur in conjunction with and be directly dependent upon other inflammatory lesions of the abdominal cavity recently presented itself to me as occasional explanation of this lesion in some cases. In one instance I observed a twisted and inflamed appendix epiploica wound around a perforating appendix vermiformis; in another, torsion of an epiploic appendage in conjunction with an acute hæmorrhagic pancreatitis. Whether the possible protective power adherent in these processes had resulted in a too sudden migration of the organ to the seat of disease with resultant torsion is difficult to ascertain definitely and admits of mere speculation. That it accounts for only a small number of cases is proven by the number of cases of torsion appearing in the literature where a careful exploratory operation revealed the twisted appendix as the only pathological finding. There are, however, two cases of foreign bodies the end-result of torsion reported by Riedel (33); one subsequent to the removal of a gangrenous appendix vermiformis, the other associated with an acute inflammatory condition of the gall bladder.

Torsion in a hernial sac may occur as a result of one or a combination of the above factors; particularly in a hernial sac of long standing, in which a chronic inflammatory process and adhesions of the contents to the sac wall incident to the use of a truss or repeated attacks of incarceration, are frequently found. Quite analogous to torsion of the appendices epiploicæ in a hernial sac is the not infrequent occurence of torsion of the ovary in strangulated herniæ of young females when this organ appears as the sole content of the sac. Here the mechanism seems to be a twist imparted to the organ (25) in its passage through the internal inguinal or femoral ring, and it is possible that the same mechanism may hold for torsion of the appendices epiploicæ under similar circumstances. Other theories proposed have been those dealing with torsion dependent upon changes in intra-abdominal pressure due to peristalsis, contraction of the abdominal musculature, etc. (Zoeppritz, 47).

Torsion of the appendages may be sudden or gradual, each process resulting in a different clinical picture. The site of torsion, whether intra-abdominal or extra-abdominal (in a hernial sac), influences the symptomatology. Sudden torsion may manifest itself in a half turn through 180 degrees or in a complete twist through 360 degrees or even in ten half turns (case reported by Adler, 1). The resulting changes in the appendages are dependent upon the degree and suddenness of the interference with their blood supply.

Sudden torsion may be accompanied by congestion of the enclosed fatty tissue with or without subperitoneal hæmorrhage; or the process may result in necrosis with complete gangrene. Gradual torsion of the appendages results in a chronic inflammatory process which may have much in common with ischæmic fat necrosis described clinically and produced experimentally by Farr (8). The gradual interference with the blood supply of these organs is attended with a splitting up of the enclosed fat into glycerine and fatty acids with the production of soaps which later may become calcified. Farr (8) has also shown that the end stage of this fat "necrobiosis" may result in cyst formation which coincides with the findings in a case reported by Hunt (12), in which an appendix epiploica had become encysted and contained "an oily, straw-colored fluid." With the changes incident to deprivation in their blood supply due to sudden or gradual torsion, these appendices are often cast off and lie free as foreign bodies (corpora aliena) in the peritoneal cavity or surrounded by omental adhesions. These bodies may vary in size from a pea to a hen's egg; are most often rounded and may show evidence of their fatty composition or may become fibrocartilaginous or even calcified. One case is on record (Virchow, 45) in which a corpusalienum was encountered along with corroborative evidence of its origin from an appendix epiploica. In fact some have gone so far as to state that only with such evidence at hand can the origin of these bodies from the appendages be definitely determined, inasmuch as calcified dermoids and old calcified echinococcus cysts may become free and appear as foreign bodies in the peritoneal cavity. Foa (9) and Neri (27) have attempted to produce these bodies experimentally.

What rôle does infection play in torsion of the appendices epiploicæ? Bland-Sutton (3) has demonstrated that the "fat content of the appendages is directly continous with that of the subserous fat." It is readily comprehended that the formation of diverticula, which in some instances actually penetrate the bases of the appendices epiploicæ, may, particularly in the presence of infection, lead to an implication of the appendages. McGrath (21) has shown the close relationship that exists between diverticula formation and the appendices, inasmuch as the latter are situated at the points of entrance of the large blood vessels into the intestinal wall, through which points of weakness herniation of the mucosa occurs. That infection of the appendices may result is well shown by the case reported by Patel (29) in which the lumen of an infected diverticulum penetrated the base of an epiploic appendage resulting in strangulation and infection of a left inguinal hernia. That the appendages may undergo inflammatory changes because of their close anatomical relationship to diverticula seems proven by the cases reported by Greaves (10), but whether or not torsion is the result of this infection seems questionable.

CLINICAL FEATURES

Foreign bodies in the peritoneal cavity, the end-result of torsion of the appendices epiploicæ, give no definite symptomatology unless infected when the symptoms and signs of peritonitis will be dominant (Riedel, 33). Some have been discovered during autopsies for intercurrent conditions; others have given rise to vague abdominal complaints simulating gall bladder disease or have been found in laparotomies in conjunction with actual torsion of one or more appendices (two cases of Riedel, 33). Sudden torsion of the appendices with or without infection results in sudden sharp abdominal pain, not necessarily limited to the seat of torsion. The pain may even be referred to the right side of the abdomen, when the torsion actually exists in an appendage of the sigmoid flexure (Harrigan, 11). Vomiting, tenderness and rigidity—in short the picture of an acute surgical condition which is usually mistaken for an acute appendicitis, cholecystitis or diverticulitis—supervenes. The appendices may give rise to an intestinal obstruction, with the usual sequence of symptoms, by becoming adherent to the parietes, or to the adjacent intestines, forming in this manner a ring through which loops of gut can become strangulated. Cases of this nature have been reported by Riedel (33) and by Hunt (12).

Intrahernial torsion of an appendage usually results in a sudden sharp pain in the inguinal or femoral region with an accompanying irreducibility of the hernial contents and the condition is usually mistaken for a strangulated hernia. Torsion in a hernial sac may occur without hyperacute symptoms (Muscatello, 26). Strangulation of an appendix epiploica in the neck of a hernial sac is indistinguishable from any other type of strangulated hernia. The symptoms are, however, less severe than when intestines are comprised but differ in no way from those when the omentum is caught. So far as I know no case of either intra-abdominal or intrahernial torsion has been diagnosed preoperatively. The treatment is of the twisted structure and ablation usually results in prompt relief.

REVIEW OF LITERATURE

The appendices epiploicæ were first described by Vesalius, later by Fabricius, Spiegel, Riolan, Glisson, Bartholin, and Willis (quoted from Robinson). Cruveilhier (6) in his work on pathological anatomy was the first to mention the presence of foreign bodies in the peritoneal cavity although Littré (18), in 1703, had previously published a case in the history of the Royal Academy of Sciences. Malgaigne (20) and Cruveilhier (6) were among the first to mention that an appendage might be one of the sole contents of a femoral, inguinal, or umbilical hernia. But to Virchow (45) belongs the credit of demonstrating the relationship between foreign bodies and the appendices. In his case the portion of the appendix remaining was demonstrated along with the foreign body which was attached by a narrow pedicle.

The literature, to date, contains twelve cases of foreign bodies in the peritoneal cavity, the first reported by Littré (18) in 1703 to be followed by the case reports of Virchow (45), Schede (36), Cruveilhier (6), Laveran (16), Neri (27), five cases by Riedel (33), and one by Hunt (12). In these cases, with the exception of Virchow's (45), it seems probable that the foreign bodies had their origin in twisted and separated appendices epiploicæ, although no actual proof is at hand.

In all, there have been seventeen cases of intra-abdominal torsion reported by the following: Tomellini (42); Riedel (33), two cases; Briggs (4); Zoeppritz (47); Ebner (7); Pochhammer (31); Morestin (24); Kimpton (14); Harrigan (11); and six by Hunt (12), which comprised the cases observed in the Mayo Clinic for a period of ten years. A case also has recently been published by Black (2). To this number I desire to add two cases of intra-abdominal torsion, one observed during a laparotomy, on a case of acute gangrenous appendicitis; the other in the performance of an autopsy, on a case of acute hæmorrhagic pancreatitis. Although the lesion was not primarily one of torsion of the appendices, in one case the appendix epiploica had to be removed on this account; for this reason I am including these two cases among those of intra-abdominal torsion.

Intrahernial torsion has been recorded ten times; two cases by Riedel (33), others by Servé (38), Muscatello (26), Mohr (23), Lorenz (19), Krueger (15), Adler (1), Linkenheld (17), and Kendirdjy (13). To this number I am adding one case bringing the total of this type of lesion to eleven.

Intrahernial strangulation has been reported thirteen times, exclusive of the case reported by Patel (29) which appears to be a perforation of a diverticulum into the base of an appendix epiploica. These cases have been reported by the following: von Bruns (5); Muscatello (26); Schweinberg (37); Verga (44); Vulliet (46); Smoler (39); Linkenheld (17), two cases; Tisserand (41); Truffi (43), two cases; and Hunt (12), two cases. To this number I can add one occurring in a left femoral hernia. Inclusive of torsion and strangulation in a hernial sac or ring the lesion is more often located on the left side, occurring in a left inguinal hernia seventeen times, in a right inguinal five times and in a left femoral hernia three times. Three cases of intestinal obstruction due to adherent appendices have been reported, two by Riedel (33), the other by Hunt (12).

CASE REPORTS

CASE 1. Intrahernial torsion of an appendix epiploica.

M. G. (private patient of Dr. A. V. Moschcowitz) Hospital No. 225300. Patient, male, age 51. For past year patient has had a hernia in the left inguinal region. On the night previous to admission he was suddenly seized with pain in the region of the hernia. Repeated emesis and much abdominal distention although his bowels had moved. Physical examination revealed an irreducible hernia in the left inguinal region which was very tender and painful. Pre-operative diagnosis, strangulated left inguinal hernia.

Operation, December 3, 1922. Hernial sac exposed. It proved exceedingly difficult to be absolutely clear regarding the hernial contents. The peritoneum was finally opened just above the constricting ring. Exposure of hernial contents showed them to be two greatly hypertrophied, acutely inflamed epiploic appendages attached to the sigmoid flexure, one of which was twisted around its pedicle until it was almost completely detached. The appendix was removed and an Andrews-Bassini hernioplasty completed. Uneventful recovery.

Specimen showed an acutely inflamed and gangrenous appendix epiploica.

CASE 2. Intrahernial strangulation of an appendix epiploica.

S. L. (Surgical service of Dr. A. V. Moschcowitz) Hospital No. 230420. Patient, female, age 40. For past year patient has been aware of the existence of a left femoral hernia which had always been easily reducible until 24 hours previous to admission. At that time patient experienced pain and noticed that hernia was irreducible. No vomiting. Mass in the left femoral region was painful and tender.

Pre-operative diagnosis, left strangulated femoral hernia.

Operation, April 6, 1923. Sac of left femoral hernia was incised revealing a left epiploic appendage, strangulated in the femoral ring. Epiploic appendage removed with typical Moschcowitz repair of femoral hernia.

Specimen revealed a hæmorrhagic acutely inflamed appendix epiploica.

CASE 3. Intra-abdominal torsion of an appendix epiploica.

M. R. (Surgical service of Dr. Edwin Beer) Hospital No. 230420. Patient, female, age 45. Chief complaint, pain in epigastrium and back for 4 hours. Examination showed an obese middle-aged female with signs of a general peritonitis.

Operation revealed an acute hæmorrhagic pancreatitis with cholelithiasis. Cholecystostomy and drainage was employed. Patient never rallied from the operation and died shortly afterwards.

Autopsy. In addition to the above operative findings, autopsy revealed a completely twisted and acutely inflamed epiploic appendage attached to the transverse colon.

CASE 4. Intra-abdominal torsion of an appendix epiploica.

A. H. (Private patient of Dr. A. A. Berg) Hospital No. 230743. Patient, male, age 45. Admitted with a typical history and physical findings of an acute appendicitis. Operation revealed a completely gangrenous appendix vermiformis with a twisted epiploic appendage adherent and surrounding the perforating viscus. Epiploic appendage removed along with appendix vermiformis.

Specimen showed an acutely inflamed appendix epiploica.

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THE EFFECTS OF RADIUM RAYS UPON THE OVARY

An Experimental, Pathological, and Clinical Study[1]

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LAST year, after reading before the Medical Society of the State of New York a paper on "The Use of Radium in the Treatment of Uterine Bleeding Other than Cancer," the question was asked whether or not the young women who received radium treatment for excessive uterine bleeding would be able to conceive and bear children following such treatment, and I was forced to answer that I did not know. Up to that time I had not made an intensive study of the subject from this standpoint, and in reviewing the literature upon radium treatment of the conditions under discussion had not come across any treatise on this phase of the subject. During the past year, however, I have made a rather complete and comprehensive study of the effects of radium radiation upon the ovary. This study included some radiation experiments done upon rabbit ovaries; a pathological study of several human ovaries that have been exposed to radium; a collection of all the available cases of pregnancy following the use of radium from colleagues from all parts of the United States. From this data I have drawn several conclusions, which I believe are justifiable and which I trust you gentlemen will criticize constructively or destructively—as they deserve.

During the past 25 years, radium has been used in many ways and in the field of medicine, particularly gynecology, it has assumed a most important place. That it is a therapeutic agent of real value there can be no doubt in the minds of those familiar with its action, but the fact must be remembered that by this agent as by many others in medicine, great damage may be wrought by a lack of the proper understanding of its inherent activity. Its physiological action may become pathological, if improperly administered, and thus cause grave and irreparable damage to the body economy. Propagation and conservation of the species are an inherent part of life, and if these functions are annihilated by the use of destructive agents directed toward the reproductive system, we as physicians are responsible.

The biological effects of all radio-active agents upon the sex glands, when administered in sufficient quantities, is well known to be destructive. This phase of irradiation we should be particularly interested in, for by the improper use of these agents, we may destroy the power of reproduction in no small proportion of the younger generation of women who are constantly being radiated for abnormal uterine bleeding. Furthermore, there are many questions that we may ask ourselves regarding the subject under discussion. Some of them are the following:

1. What pathological lesions occur in the sex glands following exposure to radium rays?
2. Will the young woman who receives a therapeutic dose of radium directed upon her generative glands be capable of reproduction thereafter?
3. What proportion of women in the child-bearing age who have had radium treatment become pregnant?
4. How many abort, miscarry, have premature labor, and how many go to full term?
5. What complications, if any, arise during the pregnancy or labor?
6. How many deliver a live healthy child? and finally,
7. Does the child grow and develop in a healthy manner? This is a big, broad, and important problem, the solution of which has not as yet been entirely nor satisfactorily accomplished.

To begin with, we have considerable literature accumulated upon the subject of the effects of radiation, both X-rays and radium, upon the processes of development, including that of plants, infusoria, bacteria, many of the invertebrate and lower vertebrate animals, but there is a real paucity of data that

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has to do directly with the effects of radium irradiation upon fertility in the human. It may be said, however, that the effects of X-rays and radium upon tissue in general are essentially identical, depending in all instances upon the "dose" administered.

Redfield and Bright showed among other things, that seeds of various plants after exposure to radium rays fail to germinate as normal seed and that if such seed do sprout and grow, the resultant plants are considerably below normal both in size and contour.

Iredell and Minett, in various non-pathogenic and pathogenic bacteria, found that radium radiation in small quantities did not retard their growth nor alter their cultural characteristics. A. B. Green, on the other hand, using relatively very large amounts of radium radiation, e.g. 1 centigram of radium bromide, screened to allow only B and C rays to pass, and placed 1 to 2 millimeters from the growth of bacteria—found that the non-spore-bearing bacteria were killed in from 2 to 15 hours exposure, whereas in the case of spore-bearing bacteria it required 72 hours or more of radiation to produce death. He furthermore found that after exposures of from 24 to 120 hours, micro-organisms themselves may, after death, show signs of radio-activity. It has not been determined whether living micro-organisms can exhibit radio-activity or not, but micro-organisms that have been killed by exposure to radium emanations can do so. Pfeiffer and Friedberg, and Hoffmann also found that bacterial growth was retarded or totally destroyed by X-radiation or radium, depending on the amount of radiation administered and the screening used. Clinically these facts excite interest, for if radium emanations are bactericidal in action, why not treat the infectious processes within the body with radium? Chemical agents are introduced into the blood stream for germicidal purposes, why not radium salts? Radium emanations are biologically destructive to all tissues and more particularly to certain types, and while the same thing may be true for the various pathological micro-organisms causing sepsis, we know that massive destruction of vital tissues must end in death of the organism and consequently sufficient radium emanations to destroy the infecting micro-organisms would undoubtedly destroy the life of the host.

Regarding the effects of irradiation upon the developmental processes in the lower animals we have a great deal of extremely valuable data. (A., G., and H. Hertwig, Perthes, Reifferscheid, M. Fraenkel, P. W. Siegel, Danysz, Regaud and Lacassagne, Baldwin, H. J. Bagg, and others.) Not all of the information gained by the experimental worker, however, can be directly applied to the human, because it is certain that a small animal—*e.g.* a rat or a guinea pig or rabbit—can withstand relatively a much larger dose of irradiation than a human can. Nevertheless, certain pathological states present in the tissues of the lower animals after radiation are certainly to be found in the human whenever the "dose" is relatively the same. Suffice it to say in this connection that all of these investigators found certain developmental retardations following irradiation of either the fertilized ova or the developing embryo at any stage of its developmental cycle. Furthermore, they also found a particular susceptibility of the nuclei of the cells of all the tissues radiated and a general slowing down of the developmental processes, especially in the central nervous system. The final morphological changes, depending upon the period of development when the radiation was applied, resulted in monstrosities conforming more or less to a definite type (Baldwin). In general the effects of radio-active agents upon development are wholly dependent upon the dose administered, the amount of screening, and the stage of development. The earlier the radiation is applied the more deleterious are the changes that take place in the subsequent development of the organism. Embryonic tissues in general are far more susceptible than the corresponding types in the adult, for it has been conclusively shown that when certain parts of a very young developing animal have been exposed to a sufficiently large dose of radiation, that part not only does not reach its normal size but fails to functionate properly. In any case there is always a latent period or

Fig. 1.

Fig. 2.

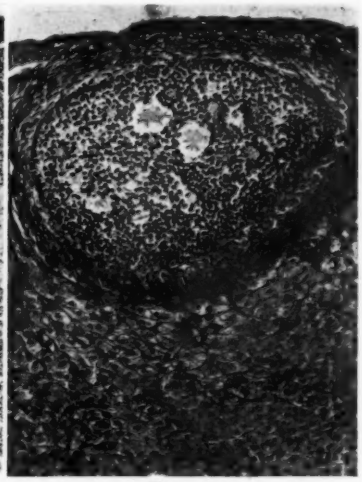

Fig. 3.

Fig. 1. Photomicrograph showing section of a normal rabbit ovary. Many primordial and ripening follicles may be seen throughout the fibrous tissue cortex.

Fig. 2. Photomicrograph showing section of a rabbit ovary exposed 30 days previously to 800 milligram hours radium (50 milligrams, 16 hours), with very few, if any, changes in the follicles, fibrous cortex, the epithelioid cells of the ovarian stroma, blood vessels, and corpus luteum.

Fig. 3. Photomicrograph of a rabbit ovary which 4 months previously had been exposed to 1200 milligram hours radium (100 milligrams, 12 hours) over left ovary. This rabbit when killed was found to be 10 to 12 days pregnant. The uterus contained 5 apparently normal young. Sections of these embryos will be studied.

a transforming stage through which all rayed tissues pass before the final morphological changes take place. In other words, there is always a varying lapse of time between the administration of any radio-active agent and its final effects upon the tissues exposed; and, furthermore, the larger the dose administered the more certain are these changes to take place and the more apparent the arrest in development becomes. Naturally, there is a dose of radiation for any type of tissue or any form of life, beyond which life can no longer exist and therefore no developmental anomalies become apparent.

The biological effects of radio-active agents, particularly X-rays and radium, upon the ovaries of many of the lower vertebrate animals—notably, mice, guinea pigs, and rabbits—are fairly well known (thanks to the researches of such workers as Reifferscheid, M. Fraenkel, Danysz, Siegel, O. Hertwig, Regaud and Lacassagne, and others from the continent, and Weiss and Maury in this country). The German and French literature is replete with such works but strangely enough, up to 1920, there was not a single article written in America upon this subject, and even today there are only two such articles to be found, viz.: that of Maury, 1920, and that of Weiss, 1923.

These investigators, either working with the roentgen-rays or radium, but usually with the former, found that when an ovary *in vivo* is radiated sufficiently there is found a round cell infiltration and engorgement of all the blood vessels, with later a marked deposition of fibrous tissue in and about the blood vessels and throughout the entire organ. The germinal epithelium is usually in a state of partial desquamation or is entirely absent. The follicles—both young and old—are particularly or wholly degenerated and filled with hyaline substance and swollen follicular cells, with no ovule or egg cell present. The cortex may be entirely free of follicles and more or less densely infiltrated by fibrous tissue (Figs. 1–8). All such changes are directly proportionate to the amount of radiation administered, the character of the screen employed, and the distance from the

Fig. 4.

Fig. 5.

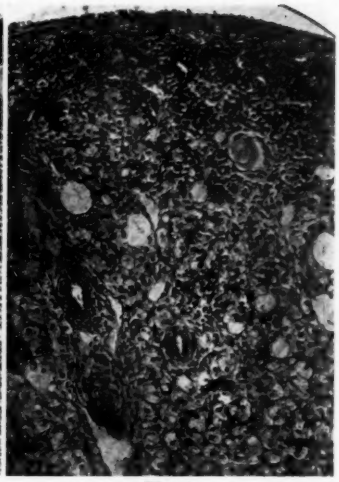

Fig. 6.

Fig. 4. Photomicrograph, section of rabbit ovary previously exposed to 1200 milligram hours radium (100 milligrams, 12 hours), showing one perfectly good follicle with its germ cell and 3 small vacuoles in its protoplasm, and several clear spaces, in all probability the site of destroyed follicles and many smaller vacuoles through the epithelioid matrix; marked increase of fibrous tissue in and about the blood vessels and throughout the cortex. The nuclei of the cells of the germinal epithelium can be distinctly seen but the cell outline can not. This rabbit could, in all probability, in the course of time, become pregnant.

Fig. 5. Normal right ovary of a rabbit whose left ovary had 30 days previously been exposed to 2400 milligram hours radium (100 milligrams, 24 hours).

Fig. 6. Photomicrograph (x 120) of section of left ovary of a rabbit whose left ovary had previously been exposed to 2400 milligram hours radium (100 milligrams, 24 hours). Section shows complete destruction of all follicles with more or less destruction of the epithelioid cells, marked fibrosis throughout the entire structure of the ovary and marked round celled infiltration. The cortex is considerably thickened, upon the periphery of which is seen the nuclei of the germinal epithelium. The clear spaces seen throughout the section represents destroyed follicles.

source of irradiation. The larger the dose, the greater the pathological changes. Furthermore, these characteristic changes do not take place immediately following radiation, but develop gradually and insiduously for varying periods of time—from 4 to 6 hours to as many weeks. Curiously enough, if a given dose of radium has not been sufficient to destroy all the follicular apparatus of the ovary, after a certain length of time, dependent upon the size of the dose, the screening used, and the amount of destruction produced, fertility is again re-established in the ovary. Rabbit A of this series of experiments received 1200 milligram hours over each ovary, usually considered a sterilizing dose, in November, 1922, and in March, 1923, 4 months later, she escaped from her cage, was covered by a neighboring buck and when killed 2 weeks later was 10 to 12 days pregnant. The cycle of events is obvious, viz.: radiation, a period of ovarian quiescence, fertility re-established, followed by pregnancy.

I have checked up these statements in rabbit ovaries using radium and have found them to be correct. Well developed young females who were known to have had at least one litter of young were placed dorsad on an ordinary animal board (such as physiologists use for demonstration on live animals); the hair and fur were removed down to the skin; a circular strip of ordinary kitchen linoleum, 2 inches wide, encircled the flanks of the rabbit directly over the ovaries. The radium was firmly attached by small copper wires to the inner surface of the encircling linoleum, as near as possible, directly over and opposite the left ovary, the left ovary in every case being exposed. The radium placed in this position was never more than 3 to 4 centimeters from the left ovary and screened with 1 millimeter glass, 1 millimeter silver, and 1 millimeter brass—the same screening that we are in the habit of using in the human, placed of course in the cervix and uterus. (See Figs. 1 to 8 inclusive.) The right ovary in some instances was removed before the left was exposed to radium. In other instances the right

Fig. 7.

Fig. 8.

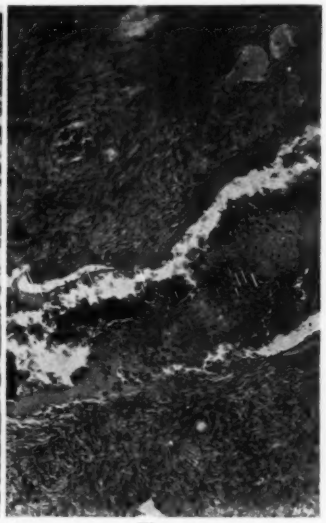

Fig. 9.

Fig. 7. Photomicrograph, low power, of same ovary as in Figure 6 showing in upper right hand section a well preserved corpus luteum. At top of section there appears a large space more or less filled with hæmorrhagic material and cellular detritus, which in all probability is the remains of a destroyed graafian follicle. No signs of follicle of any kind. The outline of the epithelioid cells are more or less destroyed and there is considerable fibrosis throughout the entire structure.

Fig. 8. Photomicrograph, high power, section from same ovary as Figure 6, showing very much thickened fibrous cortex setting upon which may be seen the nuclei of the germinal epithelium with no cellular outline. Throughout the epithelioid matrix may be seen considerable cell destruction through which are interspersed many clear vacuolar spaces resulting from this destruction of the follicles.

Fig. 9. Photomicrograph of section of ovary from woman 27 years old which had previously been exposed to 800 milligram hours radium (50 milligrams, 16 hours), showing marked œdema of all the tissues, engorgement of all the vessels, many polymorphonuclear cells in the large blood spaces, and moderate round celled infiltration about the blood vessels. (Signs of an acute inflammation.)

ovary was removed at the same time that the exposed left was removed, and there seemed to be no difference in the normalcy of the right ovary. (See Figs. 1 and 5.)

In gynecological radium therapy there is not available, at the present time, a single practical biological method to measure the effects of the various rays upon the ovary. A study of the biological reaction of all tissues to radium irradiation is, it would seem, the only way in which we can evaluate its effects. From each study will be gained some idea as to the quality and quantity of rays used and thus, finally, the therapeutic "dose" will have been established for each type of tissue and each pathological lesion.

Of special interest to us are the studies that have to do with the female reproductive system in general and the sex glands in particular. In fact most all of the histo-anatomical investigations that have been carried out in this connection have been upon the ovary.

Since 1903, there have been published many articles on the effects of the X-ray upon the ovary, but the results of the action of radium rays, which we know to be almost identical with those of X-rays, have not received so much attention, partly due to the cost of procuring the element and partly because of its scarcity. As a matter of fact, there is not a single article in English extant devoted exclusively to the effects of radium rays upon the human ovary.

From the human standpoint of this dissertation I have studied five irradiated ovaries. Mrs. C., age 27 years, received 800 milligram hours radium (50 milligrams, 16 hours intra-uterine) for uterine bleeding; curettings showed early adenocarcinoma; panhysterectomy done 8 days later. (See Figs. 9 to 13 inclusive.)

Fig. 10.

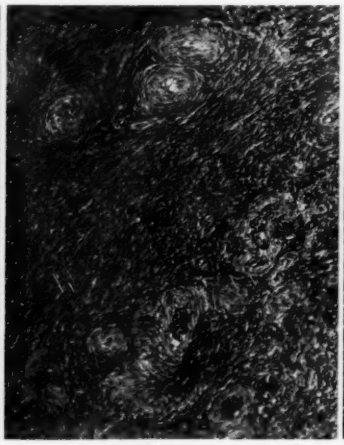

Fig. 11.

Fig. 12.

Fig. 10. Photomicrograph, high power, from same ovary as Figure 9, showing same condition. Polymorphonuclears may be seen more distinctly.

Fig. 11. Photomicrograph, high power, section from same ovary as Figure 9, showing more clearly the œdematous state of the blood-vessel walls.

Fig. 12. Photomicrograph, high power, section from ovary of woman 27 years old, same as Figure 9, showing several primordial follicles which apparently have not been destroyed by the 800 milligram hours exposure (50 milligrams, 16 hours).

Mrs. M., age 36 years, received 2250 milligram hours radium (75 milligrams, 30 hours intra-uterine) for uterine bleeding. Five weeks later, bleeding had not been controlled, panhysterectomy done, examination of specimen showed chronic metritis with marked polypoid endometritis (precancerous). The effect of the radium is shown in Figures 14 to 18 inclusive.

Mrs. S., age 40 years, menstruating regularly at the time of first examination, showing early epithelioma of the posterior lip of the cervix, with slight exudate posteriorly, received 4000 milligram hours radium (100 milligrams, 40 hours intra-uterine). Naturally she did not menstruate again. She was followed along in the dispensary and 4 months after her original irradiation, there was noticed a recurrence in the posterior lip of the cervix. The uterus remained small and the parametria at this time were perfectly movable and apparently not infiltrated. Wide, complete hysterectomy was decided upon and done at once. The effect of 4000 milligram hours of radium upon the ovaries may be seen in Figures 18 to 20 inclusive.

To show the similarity in the results of very large doses of radium—4000 or more milligram hours—I have included a section of a typical cirrhotic ovary removed from a woman 60 years old, who had not menstruated for over 20 years (Fig. 21).

It has been shown that the most vulnerable part of the ovary is the graafian follicle (Fig. 13), the primordial follicle escaping injury long after the mature follicles have been disintegrated (Fig. 12). The germinal epithelium and corpus luteum, being the most resistant, are the last to be destroyed by irradiation (Figs. 17 and 20).

There is found after the usual therapeutic doses of radium, e.g. between 800 to 1200 milligram hours, a round-celled infiltration, engorgement of all the blood vessels (Figs. 9, 10, and 11), a fibrosis in and about the the blood vessels, and a general fibrosis throughout the entire organ. Where the dose of irradiation has been sufficiently large, e.g. 2400 to 4000 milligram hours, there is complete destruction of the follicular apparatus with an extreme fibrosis in and about the blood vessels amounting in some instances to an obliterative endarteritis (Figs. 18 and 19). In such cases there is an extreme fibrosis throughout the cortex and medulla with complete destruction of the germinal epithelium and corpus luteum. There is furthermore marked hyalinization of the fibrous tissue replacing the cortex, so that about the periphery of the ovary for varying depths there is practically no cellular elements to be seen. Likewise the destroyed follicles are replaced by hyaline material together with

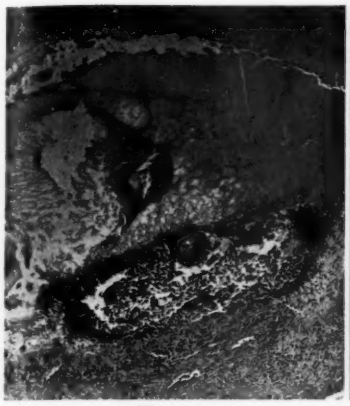

Fig. 13.

Fig. 14.

Fig. 15.

Fig. 13. Photomicrograph, moderate high power (⅙), section from same ovary as Figure 9, showing a degenerated graafian follicle containing much degenerated follicular epithelium, hyaline material, and cellular detritus—practically complete destruction.

Fig. 14. Photomicrograph of ovary of a woman 36 years old which had been exposed to 2250 milligram hours radium (75 milligrams, 30 hours intra-uterine) for essential or idiopathic bleeding; 5 weeks later was hysterectomized because bleeding had not been controlled. Section shows considerable round celled infiltration, large degenerated follicle, and there is considerable œdema. (Low power.)

Fig. 15. Photomicrograph (x 120), section from same ovary as Figure 14, showing one large degenerated follicle filled with hyaline material and cellular detritus, considerable round celled infiltration, and considerable œdema.

masses of cellular detritus. Many primordial follicles, after the usual dosage, are not destroyed but remain imprisoned in the resultant tough, hard, fibrous tissue and hence cannot easily grow to maturity and rupture, thus causing a temporary period of amenorrhœa. A follicle thus destroyed cannot be recovered and therefore we have no temporary atrophy succeeded by complete ovarian regeneration as was once thought to be the case. Indeed it is absolutely incorrect to speak of ovarian regeneration, for the ovary during its extra-uterine life can develop and gradually shed only such follicles as it possessed at birth and when these follicles shall have perished there can be no others forthcoming. Sterility is the final result.

Since the cells of the corpus luteum are remarkably resistant to irradiation and their existence thereby prolonged, we may conclude that at least part of the internal secretion of the ovary is thus preserved, for the menopause phenomena, even after complete sterilization, are not as severe as after total surgical ablation. Thus the histo-pathological findings and the clinical picture coincide and justify the assumption that the radiation menopause is less severe than the surgical.

There is evidence from animal experimentation and clinical experience to show that abortion is, to some degree at least, more frequent following irradiation. Naturally the quantity and quality of irradiation will determine the likelihood of impregnation. The earlier the pregnancy the more sure are the deleterious effects of radium rays upon the offspring and the more apt abortion is to take place.

In the first instance the radium rays, as is well known, act upon the embryonic tissue directly and oftentimes cause serious degenerative changes, resulting in abortion; whereas in the second instance the action of the rays is upon the corpus luteum of pregnancy, destroying it and thus causing abortion to take place. Again, abortion may be caused by an effect upon the unripe follicles previously rayed, but not to the degree of destruction. Such follicles, thus hampered, progress to maturity, become fertilized, and pregnancy results. Such a pregnancy may, in the very early stages, be aborted, due to the injurious effects exerted by the radium rays upon the follicle that was responsible for this particular pregnancy (Aschenheim, Werner. Steiger, M. Frankel, A. Mayer).

Fig. 16.

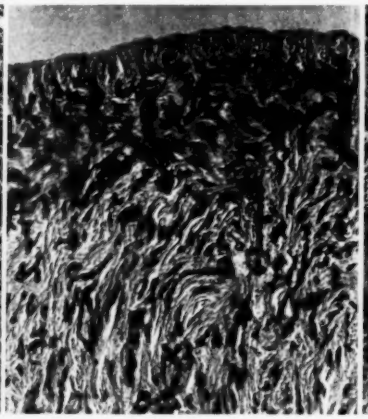

Fig. 17.

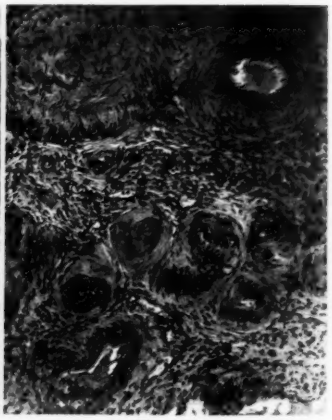

Fig. 18.

Fig. 16. Photomicrograph, high power, section from same ovary as Figure 14, showing marked increase in fibrous tissue in and about the blood vessels, marked round cell infiltration with œdema throughout all the section.

Fig. 17. Photomicrograph, high power, section from same ovary as Figure 14, showing intact germinal epithelium, the nuclei of which are fairly well preserved but whose cellular outline cannot be made out.

Fig. 18. Photomicrograph (x 120), section of ovary of woman 40 years old, previously exposed to 4000 milligram hours radium (100 milligrams, 40 hours intra-uterine)-for early epithelioma of the cervix. Hysterectomized 4 months later. Section shows marked round cell infiltration with fibrosis in and about the blood vessels, which amount in many places to an endarteritis with extreme fibrosis throughout the entire ovary, especially the cortex. No follicles, nor the remains of follicles, can be seen after study of many of these sections.

In the series herein reported of 39 pregnancies following the irradiation by radium of 874 women in the child-bearing age, there occurred 22 normal labors, and 15 abortions or miscarriages, thus making the ratio of abortions to normal labor as 1 to 2.6, whereas in Germany the ratio of abortions following X-ray and radium treatment was as 1 to 2.3 in 1,512 cases (Werner). The estimated ratio of abortions to normal pregnancies in the United States is as 1 to 3 or 4, whereas in Germany it is as 1 to 5 or 6.

Regarding the pregnancies resulting from the ova that became fertilized and were not terminated by abortion, we, furthermore, have ample evidence to show that normal progeny is the result. In our series, we have the follow-up notes of 5 of the 20 normal babies that resulted from our reported 39 pregnancies whose ages now range from 2 to 5 years and whose general health has apparently remained within normal limits.[1]

[1] I think it only fair to state that the question in the questonnaire sent out relating to the child was not filled out as regularly as the other questions, which accounts for the small number of children from this series. I feel sure there were many more children just as well and healthy as the five reported.

In Werner's series of 25 pregnancies from 1512 rayed cases, there were 14 normal children born and 10 of these were continuously followed up during their subsequent development—from 2 months to 8 years. Their development was normal generally, except 2 of these children were slightly subnormal in both weight and length in comparison to other children of the same age. This fact, however, cannot be said to be entirely due to the effects of radiation upon the follicle that was responsible for these respective children. Indeed, there are many conditions that inhibit normal development in all children—rich and poor alike.

The effects of irradiation upon the embryo is an entirely different matter and there can be no doubt but that very serious developmental defects occur following irradiation during the pregnancy state. And, as stated above, the earlier the radiation is employed the more surely will developmental defects result. The amount of irradiation given and the method of screening will determine, in each instance, the extent of the final deformity which, according to Baldwin, Bagg,

Fig. 19.

Fig. 20.

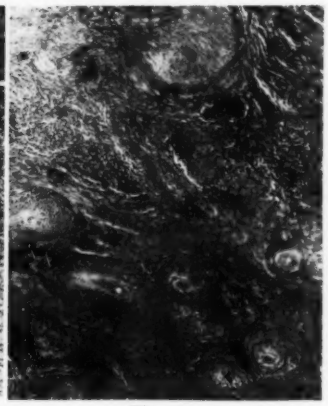

Fig. 21.

Fig. 19. Photomicrograph, high power, section from same ovary as Figure 18, showing blood vessel which has been closed by extreme formation of fibrous tissue within its walls (endarteritis).

Fig. 20. Photomicrograph (x 120), section from same ovary as Figure 19, showing a completely preserved corpus luteum, bearing out the statement that the corpus luteum is one of the last elements of the ovary to disappear under the influence of radium. Note also the many blood vessels which are closed or have only small lumen remaining.

Fig. 21. Photomicrograph (x 120), section of a cirrhotic ovary of a woman 60 years old, showing many of the characteristics of the ovary, (Fig. 19), which has been exposed to 4000 milligram hours radium. Notice extreme fibrosis in and about the blood vessels, many showing a true endarteritis, and the extreme fibrosis throughout the entire ovary.

and others is directed particularly toward the central nervous and reproductive systems, although any part of the embryo may show pathological changes. Such morbid changes must be due to an unequal effect on the various biological processes which go on side by side in the process of development, for otherwise the entire embryo, i.e., all the tissues of the embryo, would show an equal effect. A knowledge, therefore, of the selective action of radio-active agents becomes of vital importance to the clinician who expects to adopt their use.

There is considerable evidence, both experimental and clinical, to show that age plays an important rôle in the final effects of irradiation upon the ovary. M. Frankel showed that when a young active animal's ovaries were rayed with a sufficient dose of X-rays to produce sterility in an older adult animal, the ovaries of the younger animal were stunted in their growth, but were not rendered sterile. Such animals were bred and normal progeny resulted. Clinically it is certain that young, healthy women are sexually more active than their older sisters, for it is a well-established fact that ripened follicles are more sensitive to irradiation than unripe follicles. Therefore, it should require larger doses permanently to destroy the follicular apparatus of younger subjects, everything else being equal, than it does in older women who have fewer and less resistant follicles. Not all ovaries, irrespective of age of the patient, react to irradiation in the same manner. Some are more, and others are less, susceptible to the action of the rays; e.g., Mrs. B., a young woman, 23 years of age, bleeding from fibroid uterus was given 1,200 milligram-hours radium. Amenorrhœa of 21 months' duration followed, after which menses became regular. In contrast, Miss S., 30 years old, bleeding with excessive menorrhagia and metrorrhagia for 4 years with no demonstrable pelvic pathology covering a period of 18 months was given 4,650 milligram-hours radium. After 3 months' amenorrhœa menstruation began and has continued for 2 years.

CONCLUSIONS

From this study the following conclusions may be formulated:

1. Ovarian tissue in certain of the lower vertebrate animals, notably the rabbit, can

withstand relatively larger "doses" of radium rays than those of the human without loss of fecundity. This can be accounted for in at least two ways:

a. By the so-called "selective" action of the radium rays;

b. By the fact that the ovaries in the lower vertebrate animals lie near the abdominal wall and are, therefore, easily irradiated from without the body, whereas in the human the radium is usually placed within the uterus and it thereby exerts an effect upon the endometrium, so that finally there is a dual effect of the radium.

2. From our observations, rabbit ovaries do not show characteristic pathological changes due to the action of radium rays up to 800 milligram-hours. Beyond this amount they do show such changes, the extent of which depends upon the "dose" administered, the character of the screen employed, and the distance from the source of radiation.

3. The main histo-pathological changes in human ovaries brought about by exposure to radium rays in sufficient "dosage" to produce amenorrhœa for varying periods of time, e.g. 800 to 1200 milligram-hours or more, is a round-celled infiltration, engorgement of the blood vessels, and an extensive fibrosis in and about them and throughout the entire organ, with more or less disintegration of the follicular apparatus. These changes are increased in extent proportionately with an increase in the "dose" administered, so that finally there is complete destruction of all the follicles (ripe and unripe) with an extreme fibrosis throughout the entire organ, amounting, in many of the blood vessels, to an obliterative endarteritis.

4. From the data at hand it seems reasonable to state that after the usual "dose" of radium, as used to regulate non-malignant uterine bleeding, pregnancy may occur and delivery be accomplished in a normal manner. If more than 600 to 800 milligram hours or this equivalent is used, fertility, in all probability, will be destroyed.

5. The tendency to abortion is slightly more common following the use of radium. The ratio of abortions to normal labors in the series herein reported is as 1 to 2.6, whereas the normal ratio in the United States is as 1 to 3 or 4.

6. The offspring of previously radiated human subjects show no untoward effects and usually develop in a normal manner. Occasionally they are somewhat below normal in their physical development but this cannot be said to be due entirely to the effects of the radium.

7. It would seem from the data at hand—both experimental and clinical—that age is a very important factor as regards irradiation effects. The ovaries of active healthy young animals can withstand relatively much larger non-sterilizing "doses" of radium rays than the ovaries of older less active animals can. This phenomenon is undoubtedly just as true in humans.

8. In view of the present day confusion and uncertainty as regards dosage nomenclature, a universal standardized method of expressing "radium dosage" is highly desirable.

9. The employment of radium irradiation in affections of the female reproductive system should remain in the hands of those gynecologists and obstetricians who have had special training in radium therapy, for the indiscriminate use of such a valuable therapeutic agent can reflect only to our discredit.

I take great pleasure in acknowledging the very hearty co-operation of my colleagues here in New York and those throughout the United States who have so generously contributed their cases to be included in this report. I would especially mention: Drs. George G. Ward and George W. Kosmak, of New York; Drs. John G. Clark and Floyd Keene, of Philadelphia; Dr. Leda J. Stacy, of the Mayo Clinc; Dr. Thomas J. Watkins, of Chicago; Drs. John O. Polak, Leo Schwartz, Chester Duryea, of Brooklyn. Furthermore, I wish to thank Dr. Archibald Murray, of the Hoagland Pathological Laboratory, for his very kind assistance with many of the microscopical sections.

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OVARIAN IMPLANTATION

The Preservation of Ovarian Function after Operation for Disease of the Pelvic Viscera[1]

By W. L. ESTES, Jr., A.B., M.D., F.A.C.S., Bethlehem, Pennsylvania

THE devastating effects of grave pelvic inflammatory disease have long been a trial and a problem to the surgeon. The fallopian tube, being the site of the most extensive inflammation, is usually badly crippled, its function is destroyed, and the path of the ovum from the ovary to the uterus is interrupted or blocked. The obvious result is sterility of the individual. That this condition occurs often in young women from innocently acquired gonococcal infections after a single pregnancy or before any, is a further distressing factor. In treating the simple acute stage, mere palliative measures, such as rest, douches, and local heat may often be attended with success, and the patient makes an excellent recovery. In the chronic recurrent, or subacute type, however, with persistent invalidism or ill health and extensive damage to the tubes, some radical procedure is necessary—bilateral salpingectomy, leaving one or both ovaries, with or without resection of a portion of the fundus of the uterus (Polak, 16). In very extensive lesions, transplantation of a portion of an ovary may be advisable. There may be return to good health, and menstruation is preserved but sterility is practically certain.

Empirically, satisfactory surgery in chronic pelvic inflammatory disease must contemplate an operation whereby (1) the disease is eradicated, (2) menstruation is preserved, and (3) the possibility of pregnancy still exists.

Fortunately, seldom are the ovaries, or both ovaries, involved in this disease; usually one can readily be saved. Bilateral salpingectomy will remove the diseased tissues; the uterus may be kept intact so that menstruation will be retained. The peculiar difficulty, therefore, lies in arranging that the ovum extruded by the ovary shall be able to enter the uterus.

Conservative efforts to preserve the possibility of pregnancy in this disease date from 1895, when Robert Morris (13) reported an operation in which, after radical removal of the tubes and ovaries, an attempt was made to obtain pregnancy by transferring or grafting a piece of ovary to the interior of the "stump of one oviduct." A healthy portion of the patient's supposedly diseased ovary was used. Apparently, one month later, the patient did become pregnant and aborted at the end of the third month. No anatomical examination of the material was possible.

Frank (9), in 1898, recorded three cases in which one tube and ovary, and the major portion of the other tube, were removed, and a portion of the remaining ovary was implanted into the stump of the tube, and menstruation was preserved.

In 1900, A. Palmer Dudley (6) described an operation in which the fundus of the uterus was sectioned and an ovary still attached to its pedicle was placed in the cavity of the uterus "dangling like a polyp." The opening in the uterus closed about the pedicle. The remaining ovary and both tubes were removed; the patient menstruated immediately, later had a questionable period of amenorrhœa, and apparently aborted after 2 or 3 months.

In 1903, the first of Dr. Franklin H. Martin's exhaustive papers (10,11,12) on "Ovarian Transplantation" appeared. He devised a very ingenious operation for a young woman from whom both tubes and ovaries had been removed, grafting healthy ovarian tissue from another woman into the remains of the broad ligaments, and doing a plastic operation upon each uterine horn to make a new peritonealized opening into the uterus. His first case menstruated regularly for at least 2 years; a similar operation in a second case, after a sporadic show, failed to

[1] Read at meeting of Association of Resident and Non-Resident Physicians of the Mayo Clinic, Rochester, Minnesota, June 5, 1923.

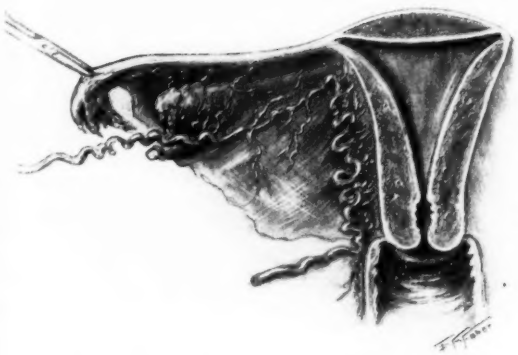

Fig. 1. Anastomosis of uterine and ovarian arteries. Blood supply of ovary.

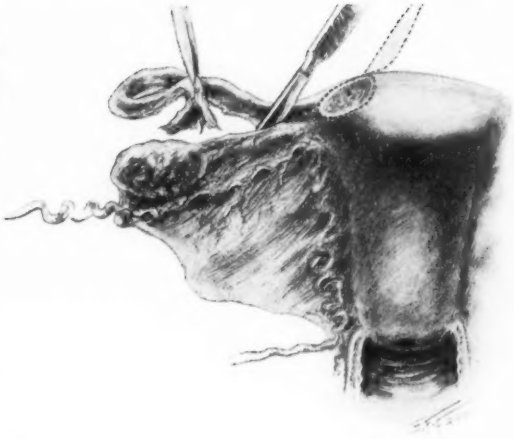

Fig. 2. Excision of tube and its insertion in the uterus. Lumen of stump shown by dot.

menstruate; apparently, pregnancy occurred in neither case.

In 1906, Morris (14) again reported that, 4 years after operation, a baby was born to a woman whose ovaries he had removed. transplanting those of another into the broad ligaments, the tubes being normal.

In 1911, Uffreduzzi (20) concluded, from experimental work on rabbits and guinea pigs, that, "with implantation of an ovary, or piece of ovary, *into* the uterine cavity, *projecting* into the cavity, or *in* the uterine cornu, pregnancy cannot occur. An ovary transplanted into the uterine wall is very quickly excluded from the cavity and is unable to ovulate directly into it." (Quoted by Chalfant, 5.)

Storer (17), in 1915, cited a case upon which, 4 months previously, a bilateral salpingectomy and unilateral oophorectomy had been done. He operated again, divided the horn of the uterus, and split the remaining ovary, leaving each half attached to the pedicle. One-half he implanted in the horn of the uterus which was closed about it. The remainder was allowed to remain *in situ*. Pregnancy, with abortion at 3 months, eventually followed.

Recently, Bainbridge (2) has reported a case operated upon in 1905, in whom both tubes and ovaries were removed, except one small bit of ovary which was entirely freed and grafted at the stump of the tube in the cornu of the uterus and covered with an omental flap. Four months later the patient, 39 years of age, menstruated, and one and a half years later had a normal labor and bore a healthy child. She continued to menstruate until 51 years old when normal menopause occurred.

Bainbridge (2), in suitable cases, has also been grafting ovarian tissue into the slit fallopian tube, or into the stump of one or both tubes, covering them with omental grafts.

Dr. Robert Morris (15) has likewise suggested the sparing of the remaining oviduct whenever possible, in cases where one tube and ovary have been removed. He simply slits the tube its entire length and drops it back in the pelvis believing that in 3 or 4 months it will recover sufficiently to function.

In an attempt to find a method whereby pregnancy could take place after bilateral salpingectomy, the following operation was evolved by my father in 1904 and 1905, reported in 1909 (7) and again in 1921 (8). It has been used in our clinic in selected cases to number now about 100.

OPERATION

With the patient in the Trendelenberg position and the upper abdomen packed off, pelvic adhesions and the tubes and ovaries are carefully and gently freed. The ovaries

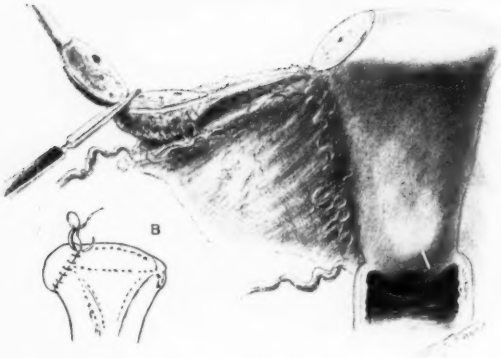

Fig. 3. Resection of ovary leaving a raw area the size of the raw surface of the uterine horn. *B*, Diagrammatic illustration of raw area of ovary sutured to the raw area of the uterus.

are thoroughly inspected and the one most normal in appearance is chosen for implantation. The other may likewise be saved if its condition justifies it. In the great majority of cases it must be sacrificed.

1. The tube and ovary of the side opposite the implantation are first removed. The broad ligament and the uterine artery, where it emerges at the horn of the uterus, are tied off. The operation is not completed on this side until the implantation has been done (Fig. 5).

2. The tube of the implanted side is then removed, together with enough of the horn of the uterus at the tubal attachment to leave a raw area the size of the cut surface of the ovary. Care is taken to preserve the anastomosis of the uterine and ovarian arteries (Fig. 1). In the center of this surface will usually be seen the opening into the uterine cavity, less than one-quarter of a centimeter in diameter, or the size of the heads of two ordinary pins (Fig. 2). There will be slight oozing but it can be readily controlled by pressure, after ligature of the uterine artery just below the operative area.

3. A longitudinal slice is then taken through the full diameter of the ovary, removing usually about one-quarter of it from the surface opposite its ligament and mesentery (Fig. 2). The amount of ovary removed depends upon the amount of cystic degeneration or inflammation that may be present. We have removed as high as seven-eighths

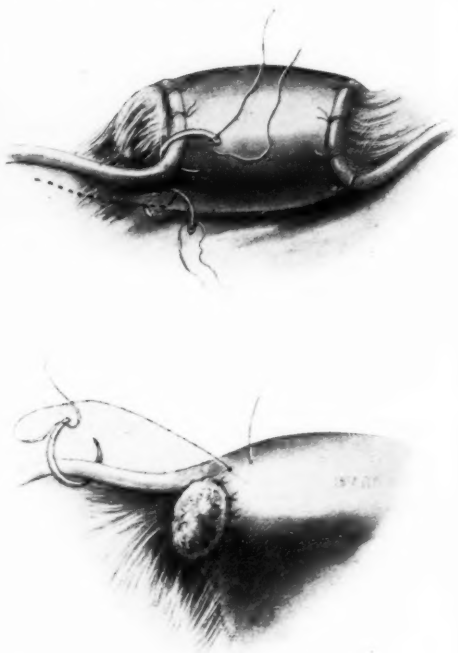

Fig. 4. Below, suture of round ligament over implanted ovary. Above, same suture concluded.

of the ovary and have implanted the remainder.

4. The cut surface of the ovary is then turned over upon the denuded area of the uterine horn and sutured in place by a continuous catgut (chromic No. 0) beginning at the inferior margin and approximating the complete circumference of the ovarian and uterine wounds (Fig. 3, inset).

5. The round ligament is then plicated over this entire area by suture to the uterus to cover and completely peritonealize it (Figs. 3 and 6).

6. On the opposite side the stump of the broad ligament is sutured to the horn of the uterus and in turn, like the implanted area, covered by the round ligament. A cul-de-sac drain, if indicated, may then be inserted. The abdomen is closed without anterior drainage.

The cases are selected with respect to (1) age, (2) social status, (3) condition of the

uterus, and (4) stage of general pelvic inflammation.

1. The operation has been performed on patients whose ages ranged from 18 to 39, the average age being 27.7 years. Young women below 30 years of age were usually chosen because in the older women there is less desire for pregnancy, and less likelihood of pregnancy occurring.

2. Women of low mental caliber or of questionable character obviously should not be given the opportunity for future pregnancy.

3. A very œdematous uterus which is evidently involved in the inflammation is considered a contra-indication.

4. No plastic operation is attempted if there is present a large pyosalpinx or pelvic abscesses.

We have had no mortality from this operation.

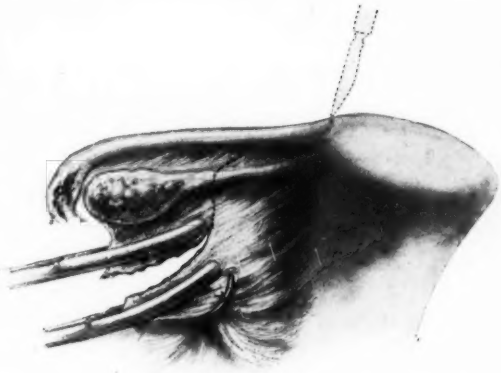

Fig. 5. Diagrammatic resection of tube and ovary on the side opposite the implantation.

END-RESULTS

We have attempted to investigate 88 cases; we have been able to obtain completed returns in 27 only. It is apparent that the great majority of the women who have undergone this operation are of the laboring class with its well-known rapid turnover and restless wandering. It is, therefore, scarcely justifiable to consider the following data as much more than a preliminary report.

1. *Operative notations.* A. Cultures were in general sterile; gonococci were found in one case; colon bacilli in one case. There were three cases of tuberculous salpingitis. The vast majority of the cases reported sterile were considered old chronic gonococcal infections.

B. The left and right ovary were used about equally for the implantation; of 40 cases, the right was employed in 20, the left in 19, and both ovaries in 1 case.

2. *After-history. A. Pregnancy.* Pregnancy after operation occurred in four cases (15 per cent of 27). There were two cases of full term pregnancy; both children are living and are normal in every way. In one the complete record is not available, but she had had no pregnancy before operation; in the other, the woman, age 30, married 3 years, who had never been pregnant, was operated upon for tuberculous salpingitis and implantation done on August 12, 1916. The baby was born on July 19, 1921; delivery was normal; both mother and child have been quite healthy since.

Two women had miscarriages at about 3 months. In neither case was any specimen available for corroborative examination. None of these four women has had more than one child or pregnancy.

B. Menses. Menstruation was regular, with usual duration and pain in 19, 70 per cent; irregular in four, either profuse or scanty; in three the report was insufficient for accurate deductions. Only one case failed to menstruate, a woman of 37 in whom only a small portion of the ovary was saved.

C. Pain. Seven, or 25 per cent, complained of some pain, usually worse with menses, either headache, backache, or pain in the same side as the implanted ovary.

D. Nervousness. Ten, or 40 per cent of these 27, acknowledged that they often felt "nervous." One, about a year after the operation developed symptoms of hyperthyroidism. Of the 27 cases, 14 had been pregnant before operation; 13 had never been.

E. Subsequent operation. Three, or 11 per cent, had sufficient discomfort or subsequent pain and disability to require another operation. A cystic enlargement of the implanted ovary was found in 2. There was no definite information as to the third, but a similar condition probably existed.

Fig. 6. Operation completed. Both uterine horns covered by the round ligaments.

DISCUSSION

In the consideration of pregnancy following an operation of this character, due regard must be paid to the possibility of pregnancy occurring after the removal of both ovaries, or both tubes and ovaries alone. Baldwin (4) has reported two cases in which pregnancy occurred after both ovaries had been removed and the tubes allowed to remain, and suggests that adventitious or accessory ovarian tissue was still present, possibly intraligamentous. In the discussion of Bainbridge's paper, both Babcock (1) and Tracey (18) cite instances of pregnancy that had followed removal of both ovaries, and also removal of both tubes and ovaries. However, 4 cases of pregnancy following a deliberate attempt to obtain it, seem to raise this procedure out of the realm of accidental coincidence, especially as in 3 pregnancy had never occurred before.

If pregnancy occurs following implantation, it must be because the surface of a graafian follicle comes in contact with the opening of the tube and heals in this position, so that when the follicle ruptures, the ovum can enter the tube.

Therefore, as the graafian follicles are in the cortex, a higher percentage of pregnancies may follow this operation, if care is taken to remove either a thin layer of the surface or fully seven-eighths of the entire ovary, so that the ovary is sectioned through the cortex and a cut section of cortex and follicles is implanted upon the uterus and tube opening. In case most of the implanted ovary is sacrificed, the other, if possible, had best be saved to insure menstruation.

SUMMARY

An operation is described for implantation of an ovary upon the horn of the uterus which may be followed by menstruation, which is usually normal in character; pregnancy may follow. There may be pain in and about the implanted ovary, or, rarely, the ovary may become cystic and require subsequent removal.

CONCLUSION

Tuffier's (19) well-known work on "Transplantation" has, since 1910, rather dominated the field, as the preservation of menstruation seems of more vital importance than the possibility of pregnancy. It is desired, however, in this report to direct attention to the possibilities of conservative ovarian implantation, *and the opportunity it affords for permitting pregnancy, as well as maintaining menstruation.*

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DEPARTMENT OF TECHNIQUE

PROBLEMS IN TREATMENT OF CARCINOMA OF THE BREAST

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As expert surgeons we have waged war for many years against a relentless foe: malignant disease of the breast, a form of cancer so prevalent and with an onset so insidious that too often our most aggressive measures fail to cure, and this in spite of the recent rapid strides in surgery in other directions. Selecting the most favorable operable cases, with the cancer apparently confined to the breast tissue only, Halsted and Deaver have quoted 80 per cent as cured by operation; on the other hand, where the disease has demonstrably extended into the axillary glands our surgical intervention succeeds in curing from 12 per cent (Greenough) to 4.3 per cent (Finsterer).[1]

Radium therapy has come recently to hold out a legitimate promise of becoming at least our most valuable adjunct to surgery, and it is now our important task to develop the technique of the applications, raising them to the same effective plane as that of our present surgical methods.

EARLY OPERABLE GROWTHS

Firing at a target hidden behind a bush is always a serious handicap; the intervening foliage obscures the bull's-eye and leaves one in doubt regarding the best caliber of bullet, the most effective distance, and the number of shots necessary for a perfect score. In the same manner, when there is an incipient carcinoma in the breast without tangible glandular metastases, it is impossible to predict the extent of the disease, and for this reason we are hampered in the accurate focussing of our γ-rays and in delivering an effective dosage in all possible affected areas. Hence surgery properly takes precedence over radium therapy in all good operable risks. The surgeon removes the bush which screens the lurking disease, and the disease itself, as far as possible. Later local recurrences are fortunately obvious and offer a superficial target which radium can usually obliterate.

Since Cullen, Clark, and others, by their splendid propaganda in medical and lay magazines, have posted the public about the dangerous potentialities of any lump in the breast, we find in common with other surgeons that many cases come earlier for diagnosis and treatment.

Our own technique, followed for many years past, is in all cases to examine the breasts with minute thoroughness, including the axillary and the supraclavicular areas. Then we take an X-ray plate of the chest uniformly in all the cases, as first suggested by Curtis F. Burnam; it is pertinent to remark how often patients unexpectedly show pulmonary or mediastinal involvement even with a small breast lesion. If the patient proves a good operative risk a radical breast and gland enucleation is the immediate imperative step. In cases of doubtful malignancy the breast nodule is first excised and the tissue sectioned, stained, and examined at once during the operation. It is too little known that this practice of immediate sectioning, staining, mounting, and examining originated in my clinic with Dr. T. S. Cullen.[2] As a rule the diagnosis is so clearly made that the section is filed and considered sufficient for the permanent record. If malignancy is found, the radical operation is proceeded with. I cannot urge with too great importunity the advisability of operating upon every doubtful case; the natural inclination to "observe" the uncertain case has cost many a life even in the best hands.

About 10 days after the operation a heavy radium treatment is given in an effort to destroy any cancer cells left behind by the knife, five or six equidistant portals being chosen along the line of incision and a gram at one-quarter of an inch filtration applied for 10 to 12 minutes to

[1] Boggs, Russell H. The treatment of carcinoma of the breast by imbedding radium, supplemented by X-ray. Am. J. Roentgenol., 1921, viii, 272.

[2] Cullen, Thos. S. A rapid method of making permanent specimens from frozen sections by the use of formalin. Johns Hopkins Hosp. Bull. (April, 1895, No. 49).

Fig. 1. H. T. Photograph taken November 29, 1922, shows how completely the breast had sloughed away.

each. Also the axilla and supraclavicular spaces are radiated, giving at 2 inches the equivalent of 5 or 6 grams for an hour. Application of radium to the neck and to the axilla demands great care: the package must be adjusted accurately and the surrounding skin protected with heavy lead, a precaution which as well as protecting serves to prevent slipping of the box to one side or the other—an accident which might result in a severe "burn." Just as a surgeon develops an "aseptic conscience" so must the radiologist acquire a strong "protective instinct." On completing the treatment outlined above, the patient is discharged, but with strict injunctions to be kept under observation at increasing intervals of time for several years, and treated with radium if there are recurrences. The value of general mere prophylactic treatments is more than doubtful.

Some advocate a general radiation of the breast preliminary to operation,[1] also of questionable utility, for it is certain when disease once appears

[1] Pfahler, G. E. Radium combined with X-ray treatment in carcinoma of the breast. Am. J. Roentgenol., 1921, viii, 11.

Fig. 2. H. T. Condition of arm in January, 1923.

such spraying methods are not of the slightest avail in eradicating it.

INOPERABLE CASES

Bad operative risks, and patients who refuse operation, and cases in which the growth has metastasized to the neighboring glands or to the mediastinum, vertebræ, or ribs, or those presenting recurrences after operation, have radium left as their one hope. In sifting this group, it is obviously as useless to radiate pulmonary metastases, as it is to operate. Metastases to the spine, on the other hand, are often helped in a remarkable and unexpected manner by heavy treatments, which serve to alleviate the pain and often enable the patient to live a year or two longer in comparative comfort. In some of our patients in this group, there has even been an evident deposition of new bone with resumption by the patient of the normal relations in life: almost a resurrection!

Large inoperable breast cancers can be heavily radiated without injury to the skin by the implantation of tiny glass spicules (also called "points" and "seeds") containing radium emanation in addition to the external applications. Treatment here alleviates pain as well as retards ulceration and sloughing of the tumor. Sometimes there takes place a marvelous *restitutio ad integrum* so that the whole area presents the appearance of undergoing complete resolution. The end in this group though often delayed is

always lethal on account of the metastases. Recurrent nodules on the chest wall, usually lenticular in form, disappear as by magic under proper dosage. We had one of these massive cases sent to us by Halsted about 8 years ago, where he found it hard to accept the evidence of his own eyes in the face of facts so utterly controverting all his previous extensive experience.

Radium treatments of inoperable growths are always painless. The effect is to alleviate pain, to prevent ulceration and sloughing, and to give the patient a year or more of life. Better results still may be looked for within the next few years from improvements in the technique of administration.

"CANCER CURES"

Another of the problems of the radiologist is the proper treatment of patients who have been deprived of all their chances by cancer quacks using salves and pastes, a literal slow assassination. The following is illustrative.

Mrs. H. T. of Jacksonburg, West Virginia, age 41, entered the Howard A. Kelly Hospital, November 29, 1922. She had noted a lump in the right breast and another under her right arm a year and a half before admission. Some radium and X-ray treatments were given in Columbus, Ohio, without obvious improvement, so she drifted into the hands of a notorious "cancer specialist" in Kansas City. In June, 1922, by a twelve-day application of a black paste he removed the right breast—but, unfortunately, did not touch the axilla, the important seat of the disease. Examination on admission showed that her condition was utterly hopeless: the entire right axilla formed a rigid, carcinomatous mass, and there were multiple nodules above the clavicle. The photograph taken November 29 (Fig. 1) shows how completely the breast had sloughed off, neglecting the cancer above. An X-ray plate of the chest here was negative. Measurement through the chest above the line of the breast was 15.5 centimeters on the right side compared with 7.5 on the left. The right arm was greatly swollen, the upper arm measuring 32.5 centimeters in circumference and the forearm 26 centimeters in comparison with 26.5 centimeters and 22 centimeters at corresponding levels for the left.

Palliative radium treatments were given to the right anterior axillary fold and the right supraclavicular region, giving some relief. By the middle of January, an ulcer had appeared in the scar on the right chest; the growth had increased in the axilla and the right neck; the œdema of the arm had increased so that the measurements of the right arm were 39 and 34.5 centimeters (Fig. 2). This œdema was relieved by a Kondoleon operation performed January 25, 1923, joining the superficial and deep lymphatics of the arm with a wide excision of the fat, fascia, and aponeurosis along the entire outer median surface of the arm.

She died April 28, 1923.

Quackery is not confined, however, to the application of pastes and salves. Radium in the inexperienced hands of regular doctors is a form of quasi-quackery just as dangerous; the knowledge of proper dosage is only acquired by patient

Fig. 3. Case 1, M. S. B. Skin irritation from heavy radium dosage.

endeavor and the closest study of results of treatments. All the larger radium hospitals are glad to instruct visiting doctors in problems of radium dosage. Too light a treatment stimulates the growth and also loses valuable time; too heavy a dose produces a burn, breaks down healthy tissue, and destroys resistance. The following instance illustrates the result of misdirected effort: two years ago a patient entered the hospital with the ensuing history.

A radical operation for breast carcinoma had been followed within a few months by an axillary recurrence. The surgeon then told her that further operation was not indicated, but that radium therapy might help. The patient consulted the doctors of a radium corporation. Their method of treatment consisted of the daily injection of 1 cubic centimeter of a solution of radium into the veins of the arm. She endured this treatment for 2 months, not knowing, naturally, that a daily injection of common salt solution would have had an equal effect on the growth. When seen here the loss of time had precluded all chance even of relief, and she was in great pain, carrying her enormously swollen arm on a pillow supported by a sling.

CASES BENEFITED BY OPERATION AND RADIUM

Now let us consider a group in which favorable response to operation and radium is a splendid encouragement to persist and improve this mode of treatment. A few cases, selected from 550 treated, follow.

Fig. 4. Case 3, L. M. Recurrence of mass.

CASE 1. Miss M. S. B., age 47, was admitted January 19, 1914, for treatment of recurrent carcinoma of the right breast. The original growth had appeared 7 years ago. Six months after its appearance the breast was removed by operation, but in another 6 months another nodule formed lower down on the chest wall. This was extirpated one and a half years later, followed by a third operation for recurrence in another year's time. On admission there was an infiltrated area in the chest wall 5 by 3.5 centimeters at the lower end of the scar. Heavy radium treatments were given January 23, February 15, and April 7, 1914. These resulted in complete disappearance of the recurrence, although burns ensued from the heavy dosage, as shown in Figure 3. Then there was absolutely no recurrence of the trouble until September, 1921, when the left breast became involved, and when last heard from, in December, 1922, her general health was excellent and she was undergoing deep X-ray therapy for this last recurrence.

CASE 2. Mrs. H. J. W., age 46, was admitted February 9, 1916, for treatment of recurrent carcinoma of the left breast with metastases to the mediastinum. The patient had suffered with mastitis in this breast 24 years ago. The growth appeared in 1905. A cancer paste was applied at that time which made conditions worse. July 6, 1906, Dr. Lamb, of Corning, California, removed the lump from the left breast and the glands from the left and right axillæ. Nine weeks after the operation a blue lump appeared in the left breast. A week before admission the left breast ulcerated, and was discharging when first examined here. An X-ray of the lungs on admission showed a small mass in the lower right lung indicating metastasis, and some suspicious spots in the left lung. February 11, 1916, a complete removal of the left breast was performed at this hospital, followed by heavy radium treatments to 12 chest areas on March 12, 1916. The patient convalesced normally. Since this time she has been in excellent health and shown no sign of recurrence, as reported by her doctor on November 28, 1922.

CASE 3. Another patient, Mrs. L. M., age 72, entered the hospital October 2, 1917, with scirrhous carcinoma of the left breast complicated by extensive axillary glandular involvement and also by involvement of the axillary vein. The presence of the growth had been noted for 3 months, but there had been no previous treatments. Amputation of the left breast was performed here October 5, 1917, with removal of the axillary glands, and with extirpation of the infraclavicular glands on October 17, 1917. This was followed by four heavy external applications of radium from October 27 to November 1, 1917. In December of this year the wound was reported perfectly healed. Only temporary relief was anticipated as at operation the axillary vein was found to be involved in the growth. However her local doctor reports (December 28, 1922) that the patient is still living and her present condition is good, except that she is a morphine addict.

CASE 4. Mrs. J. F. W., age 49, was admitted December 29, 1913, for treatment of recurrent carcinoma of the right breast. Dr. Barber, of Rochester, New York, had removed the right breast 3 years ago, and a recurrence had appeared 1½ years ago. December 29, 1913, a carcinomatous gland was dissected out from the right axilla and spicules of emanation were implanted, and three heavy external radium treatments were added, ending January 1, 1914. By January 27, 1914, the mass treated had disappeared. On April 27, 1914, the patient returned with a recurrence of the mass (Fig. 4). The left breast was clear and lungs and both axillæ were free of trouble. By June 10, 1914, the mass had dwindled to the size of a quarter. June 29, 1914, the patient returned and a nodule near the right sternal margin was removed and another heavy radium treatment given. The patient has been repeatedly examined since, and no return of the trouble has been found. She last reported (October 11, 1922) that she was enjoying splendid health.

CASE 5. On April 11, 1917, Mrs. C. A. G., age 45, entered for treatment of a huge scirrhous carcinoma of the right breast involving the entire breast with widespread metastases and large palpable axillary glands. There was also a large gland over the right clavicle and one in the left axilla. Left breast was negative. An X-ray of chest on admission was negative. Heavy treatments were given through the month of April with remarkable improvement. In May the large palpable glands in neck and axilla had disappeared as a result of the radium treatments, leaving only the trouble in the breast; hence on August 13, 1919, complete amputation of right breast was carried out after heavy radiation. Repeated examinations were made; no trouble found by November, 1920; result confirmed in April, 1921; June, 1922 no evidence of disease; a gain of 20 pounds in weight and in excellent general health. When last heard from in November, 1922, there had been no further recurrence.

CONCLUSIONS

Aggressive radium therapy complementary to surgery offers the best prognosis when dealing with malignancy of the breast. The technique of γ-ray treatment has been difficult but is improving from year to year, just as surgical methods have progressed in the past. Results as yet are not brilliant, as the radiologist is apt to be used as the final court of appeal called in the most hopeless cases, often where every other line has failed and only too often where unscrupulous methods have deprived the patient of all possible hope of life or even of relief from suffering.

ROENTGENOLOGY OF THE MALE URETHRA; NOTES ON THE ANATOMY, PHYSIOLOGY AND PATHOLOGY

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THE most important recent advance in urologic diagnosis was the introduction of the roentgen-ray examination of the upper urinary tract after the renal pelvis and ureter had been filled with an opaque solution. In 1910, Cunningham applied a similar method to the male urethra, and was able to demonstrate the outline of strictures in the roentgenogram. Uray, in 1912, and Pfister, in 1920, also used this method for the diagnosis of urethral stricture and fistula. Their technique was, briefly, as follows:

The urethra was filled with an opaque medium, suspensions of barium sulphate or bismuth subnitrate, the external orifice closed by compression, and the roentgenogram made by a dorsoventral exposure. They were unable to show the posterior urethra, and the bulbous portion of the anterior urethra was poorly defined because of overlapping of shadows. Haudek, in 1921, worked out a definite technique for showing, in profile, the outline of the entire urethra. He placed the patient in the dorsal position, and then tilted the pelvis to an angle of 45 degrees with the horizontal. The sensitized plate was placed beneath the pelvis (Fig. 1) with the Coolidge tube centered over the symphysis and perpendicular to the plate, and the exposure was made during the injection of the urethra with a 10 per cent solution of potassium iodide. In this manner the anterior urethra, bulb and posterior urethra were clearly shown. Two French observers, Béclère and Henry, have recently used the method in the study of stricture.

In the beginning of the present investigations certain cases of strictures were studied by Haudek's method, but later his technique was modified so that by first filling the bladder with an opaque solution, and then making the urethrogram, the outline of the entire lower urinary tract was revealed. Observations were made on a variety of lesions of the urethra and bladder outlet, as well as on a number of normal cases. Two points in technique are emphasized. The pelvis must be inclined at an angle of 45 degrees with the horizontal, in order to show the outline of the urethra in profile; and the opaque solution must be flowing through the urethra into the bladder during the entire time of exposure. If the urethra and bladder are merely filled, and the external orifice is sealed before making the exposure, there will be no shadow cast by the posterior urethra because it is empty (Fig. 2). A number of opaque solutions and suspensions may be used, but a 5 per cent emulsion of silver iodide has been found the most satisfactory.

This method of diagnosis is not without danger. It should not be used immediately after cystoscopy. Too much force should not be used in injecting the solution because of the danger of extravasation from a diseased urethra. It also has limitations as a diagnostic procedure, and in no instance will it displace direct inspection through the urethroscope, when the latter can be used. By applying the method to a number of normal cases, interesting observations were made on the anatomy and physiology of the male urethra. It was noted that the injection fluid always meets resistance at the distal entrance to the posterior urethra, and as a result the bulbous portion dilates markedly (Fig. 3). Then, as a result of injection force and muscular relaxation, the fluid enters the posterior urethra and passes into the bladder. The posterior urethra always can be definitely located between the bulbous expansion and the outline of the base of the bladder, and appears in the roentgenogram as a very narrow shadow connecting these two parts. The narrow shadow is characteristic of the posterior urethra; I have not been able to distend it beyond this point. As I have stated, the posterior urethra is empty and will not cast a shadow if the opaque solution is not flowing through it during the entire time of exposure. This will occur in spite of the fact that the bladder is distended at one end, and the bulbous portion of the anterior urethra at the other. Regardless of the degree of distension of the bladder, the narrow streak of opaque solution from the posterior urethra joins the base of the bladder at a right angle. These observations seem to indicate that (1) the posterior urethra is normally in a state of constant tonic contracture and closure; (2) it maintains this condition of closure in the presence of a distending force on either side; (3) the posterior urethra never becomes a part of the bladder, creating the so-called "vesical neck" even when the bladder is fully distended, and (4) the entire length of the posterior urethra

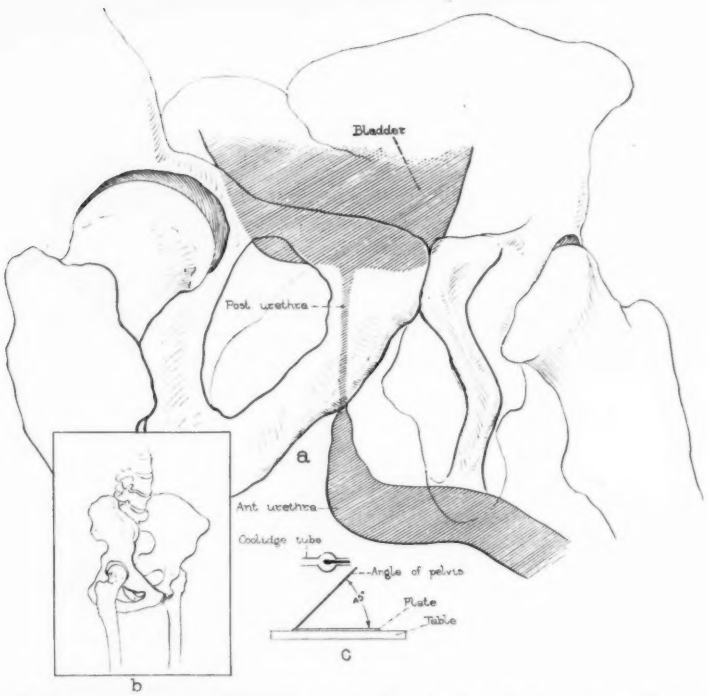

Fig. 1, a. Outline of urethra and base of bladder showing relation to bones of pelvis as seen in urethrogram. b. Position of pelvis in making urethrogram. c. Angle made by pelvis with plate and position of Coolidge tube.

takes part in maintaining the closure of the bladder, there being no evidence of an internal and an external vesical sphincter with separate and independent functions.

According to Piersol, the musculature of the urethra is composed of an inner longitudinal and an outer circular layer. If the action of the internal vesical orifice is observed through a suprapubic opening, during the act of micturition, what appears to be a pulling down of the trigonal region into the posterior urethra will be seen. Leedham-Green has shown that the vesical sphincter serves to maintain perfect closure of the bladder without the appearance of a funnel, even in the presence of enormous intravesical tension. In the performance of cystoscopy in patients having cord lesions, such as tabes dorsalis, varying degrees of relaxation of the internal sphincter may often be noted but, as Caulk and his coworkers have shown in their study of the nervous diseases of the bladder, the relaxation of the sphincter must be extreme before funneling appears in the cystogram (Fig. 4). Results obtained by a combined study of the urethra and bladder are in accord with the foregoing observations. The musculature of the posterior urethra is intimately connected with that of the prostate, both anatomically and physiologically. It has been asserted that, in cases of enlargement of the prostate, the gland, by pushing into the bladder, displaces the internal sphincter toward the periphery with resulting loss of its function. I have been unable to find proof of this. Urethrograms made in cases of enlarged prostate have shown normal vesical closure (Fig. 5). I believe that the collar of muscular tissue in the brim of the cavity following prostatectomy is the musculature of the wall of the bladder, and not the displaced internal sphincter.

What, then, are the changes at the vesical outlet that follow the removal of the enlarged prostate by the suprapubic route? Wallace and Page, in 1911, were perhaps the first to report the appearance of the cystogram following prostatectomy. They noted the presence of a prostatic pouch, but they also observed that in certain

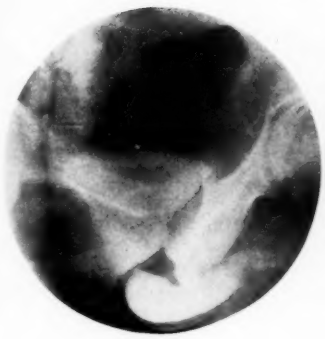

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 2. Combined urethrogram and cystogram. Note normal dilatation of bulbous portion of urethra. Posterior urethra not shown because injection was not made during time of exposure.

Fig. 3. Normal urethrogram showing anterior urethra, penoscrotal angle, bulb, narrow shadow of posterior urethra, and bladder. Note absence of vesical neck or funnel.

Fig. 4. Cord bladder showing funnelling at base of bladder and shortened posterior urethra.

Fig. 5.

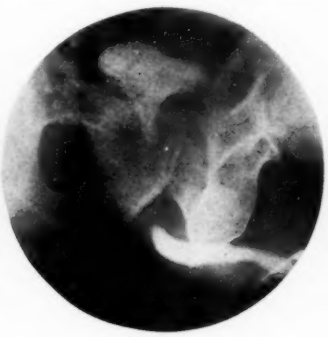

Fig. 6.

Fig. 7.

Fig. 5. Combined urethrogram and cystogram in a case of prostatic hypertrophy showing normal anterior and posterior urethra, with elevation of base of bladder. Note perfect bladder closure.

Fig. 6. Roentgenogram taken 6 months after suprapubic prostatectomy and showing funnel at outlet of the bladder.

Fig. 7. Four weeks after suprapubic prostatectomy. Note perfect vesical closure and absence of funnel or pouch. Posterior urethra shorter than normal.

cases the cystogram showed a straight base line. They concluded that a man can micturate normally without an efficient internal sphincter. Hyman made cystograms in 38 patients after prostatectomy. In 28 there were two cavities, one the bladder, the other the pouch formerly occupied by the prostate; in the remaining 10 only a slight funneling occurred, and in a few no changes from the normal were noted. In the study of cases after prostatectomy I have noted the funnel (Fig. 6), in certain instances, and also, rather often, the absence of either funnel or pouch (Fig. 7). Urethrograms were made in these cases, and they showed the characteristic narrow shadow of the posterior urethra leading up to the base of the bladder, or to the apex of the funnel. The shadow was shorter than normal, because of the absence of a portion of the prostate and urethra. I wish to make it clear that even after removal of the prostate a considerable portion of the posterior urethra remains. It has been observed at necropsy, in cases in which the prostate had been removed 6 months or a year previously, that the base of the bladder is sometimes smooth, there being no evidence of a pouch or funnel. Tandler and Zuckerkandl have shown that in suprapubic prostatectomy only the portion of the gland above the level of the colliculus is removed, and that a portion of prostatic urethra surrounded by prostatic tissue remains. My study seems to show that the remaining portion of prostatic urethra with its musculature, as well as the compressor

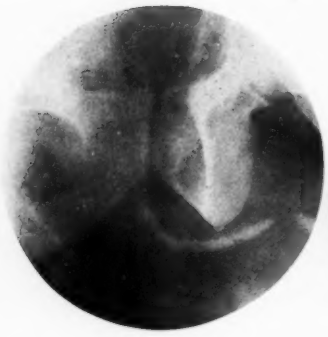

Fig. 8.

Fig. 9.

Fig. 10.

Fig. 8. Urethrogram of stricture showing contracture of entire anterior urethra.

Fig. 9. Multiple strictures of urethra, suburethral tract, and multiple perineal fistulæ.

Fig. 10. Diverticulum of the posterior urethra connected with a small contracted bladder. The entire prostate had been destroyed by tuberculosis.

urethral muscle, plays an important part in vesical control after prostatectomy. The presence or absence of a pouch after enucleation is of little practical importance so far as function is concerned.

Urethrograms made in cases of stricture have shown the interesting fact that the entire anterior urethra is often involved in a cicatricial process which converts it into a narrow inelastic tube. The characteristic distensibility of the bulbous portion is lost (Fig. 8). I was unable to demonstrate stricture of the posterior urethra, because the normal shadow cast by this part is very narrow; but in cases of stricture with incontinence of urine, the opaque solution could be seen flowing without interruption into the bladder. In two cases of stricture following fracture of the pelvis, there was present in the urethrogram a peculiar break in the continuity of the urethral shadow, like the displacement of fractured parts. Cases of multiple strictures of the anterior urethra, which do not permit the passage of an instrument, can be readily located and outlined in the urethrogram. In two cases of stricture of long standing the presence of a suburethral tract parallel with the main canal was noted, probably the result of tunneling by an instrument (Fig. 9). Perineal urinary fistulæ usually originate in the bulbous portion of the urethra. The number and tracts, as well as their point of origin, can be demonstrated in the urethrogram.

Diverticula of the posterior urethra may be congenital or acquired. A large diverticulum of the posterior urethra, the result of tuberculous abscess of the prostate in a boy, was revealed in the urethrogram as a large cavity, equal in size to, and connected with, the bladder (Fig. 10). Several cases of penile hypospadias were studied, but the outline of the urethra appeared to be normal. In a true bilateral hermaphrodism, the outline of a normal male urethra was shown.

Roentgenographic shadows in the region of the vesical outlet, caused by prostatic calculi or stones in the posterior urethra, are occasionally difficult to localize. The accurate localization of such shadows can be made by urethrograms.

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RADIUM IN THE TREATMENT OF VASCULAR NÆVI

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WICKHAM and Degrais (1) were the first to publish an extensive account of the results obtained with radium in the treatment of vascular nævi. In American literature, articles dealing with this topic have been published by Newcomet (3), Montgomery and Culver (4), New (5), the writer (2), and by a few others. With the exception of my chapter in *Oxford Surgery* (6), few, if any, modern works on surgery or dermatology contain more than a casual reference to this mode of treatment. The method apparently has not gained a wide degree of popularity, perhaps because of the costliness of the necessary equipment.

In the last ten years I have treated with radium more than 300 cases of vascular nævi. Not all cases have been treated with the success, from a cosmetic standpoint, that was at first thought possible. I believe, however, that this method of treatment is, in most cases, the best that is now available. In dealing with nævi that are very extensive and growing rapidly it is the only method that promises any degree of success.

METHODS OF TREATMENT

In rare instances, vascular nævi may disappear spontaneously. Sometimes ulceration may occur and involve a part or all of the nævus, the final result being its partial or complete disappearance with scar formation. In some cases, a nævus may appear a few days after birth and grow rapidly. In other cases, it may increase in size very slowly as the child grows. In most cases, after a nævus appears, it remains stationary.

We believe that it is unwise to allow nævi to remain without treatment on the ground that they may disappear spontaneously. Nævi that are growing or become ulcerated should have immediate treatment. Nævi that merely cause disfigurement may be treated in more leisurely fashion but they are more amenable to the treatment when it is begun in earliest infancy.

The object of the treatment of vascular nævi, when it is undertaken for cosmetic purposes is, of course, the decolorization and in some cases the leveling of the tumor so as to render it less unsightly. Uniformity of coloring and smoothness of the surface of the treated areas must be attained if possible. Dangerous and very painful methods of treatment should, we think, be abandoned. Methods that are liable to result in unsightly or uneven coloring or that are productive of keloidal or excessive scar tissue should also be given up.

Various physical, chemical, electrical and actinic methods have been used. The principal methods, other than the use of radium, are:

1. Surgical procedures, such as excision, ligation, scarification, etc.;
2. Intense heat or cold (actual cautery or freezing);
3. The injection of various substances, such as boiling water, hydrogen-peroxide, tincture of iodine, etc.;
4. Chemical caustics, as nitric, sulphuric or glacial acetic acid, etc.;
5. Electrical methods, as electrolysis, electrocoagulation, or the high frequency current;
6. Actinic therapy, such as X-rays, or the Kromayer lamp.

Surgical or operative procedures are suitable, as a rule, for small nævi only. Pedunculated nævi may be treated by excision. In certain types, such as the cavernous nævi, there is some danger of serious or even fatal hæmorrhage as a result of excision, and recurrences are not unusual. The cosmetic results of surgical procedures are usually inferior to those obtained by other means.

The cautery is seldom used at the present time and we think it should be abandoned altogether.

Freezing with liquid air or its more convenient substitute, carbon dioxide snow, has had some degree of popularity. This method has the advantage of being rapid and economical. It appears to be of most value in superficial cavernous nævi of small extent. It may be used in certain cases as an adjunct to radium treatment, as in the clearing up of very small foci. The freezing method is painful, however, and hence cannot be repeated indefinitely in the same patient and especially in dealing with children. It should not be used in flat nævi of the "port wine stain" type. In extensive cases it is next to impossible to obtain a good cosmetic result as the coloring of the skin may be uneven. In some cases keloid may develop from its use. After a considerable experience with the freezing method we have abandoned it altogether except in rare cases and usually as an adjuvant to other measures.

Fig. 1. Purplish red, vascular nævus of raised "hard" type, involving left side of cheek and upper lip in girl aged 21. Photograph taken September, 1913. The presence of considerable connective tissue in the angioma renders the treatment of this type of nævus quite difficult.

Fig. 2. Patient in figure 1, 9 years after removal of nævus with radium. For several years following treatment patient was subject to slight attacks of dermatitis involving treated area. Surface of nævus is smooth and decolorized. Photograph, taken May, 1923, not retouched.

The injection of various substances into vascular nævi is not to be recommended. The method is painful and not without danger.

The use of chemical caustics has practically been given up. Caustics are painful and their use may be followed by keloidal or scar tissue. Glacial acetic acid is sometimes of value in the treatment of very minute areas.

Electrolysis is of value in the treatment of "spider nævi" and small telangiectatic areas. Injudicious electrolysis may be followed by scars or keloids. Electrocoagulation and the high frequency current may be useful in rare cases. The electrical methods are all painful and are not adapted to large tumors.

X-rays have been used in vascular nævi and in rare cases with very good results. It would appear, however, that to be successful the dosage must be pushed to the point of producing a mild dermatitis. X-rays have apparently no constant or marked effect on large angiomatous tumors.

The γ-rays from radium, however, have a very pronounced effect on all types of angiomata. We cannot agree, therefore, with those authors who hold that γ-rays and X-rays are practically identical in their action. The Kromayer lamp was employed at one time with some prospect of success in selected cases of superficial flat nævi (port wine stains). In some cases this method has been used in conjunction with radium "toiles" as suggested by Wickham and Degrais. We have now, however, abandoned the Kromayer lamp altogether in the treatment of nævi.

ADVANTAGES OF RADIUM TREATMENT

Radium is unique in the fact that it exerts a marked action on the blood vessels of the nævus, other tissues being only slightly or not at all injured.

The painlessness of radium is one of its points of superiority over other methods. This factor is of importance especially in the treatment of children.

If the method of application is correct, there is very little scar tissue following the use of radium. Contractures seem never to occur—a feature of great importance when angiomata are situated about the eyelids, nose, or mouth.

The cosmetic results are usually superior to those obtained by other methods. As in all cosmetic disorders, the results of treatment naturally depend very largely upon the care and fidelity to detail with which the treatment is carried out.

In rapidly spreading nævi and in cases occurring in infants in which the lips are involved and

Fig. 3. Purplish red, vascular nævus of raised "soft" type, involving left side of face including mucous membrane of lips in baby aged 6 weeks. Photograph taken September, 1913. Patient referred by Dr. David Lieberthal.

suckling is seriously hindered, life may be saved by prompt radium treatment.

DISADVANTAGES OF RADIUM TREATMENT

In some cases radium treatment is slow and tedious and the economic features must be considered. In children, however, the time factor is usually of little importance provided the final cosmetic result is good. In the course of a few days or at the most, in two weeks, sufficient treatment can be carried out to produce a marked effect on the nævus even in the most extensive cases.

In some cases in which a sharp inflammatory effect may have been produced by the treatment and the skin later on may have become atrophic, attacks of dermatitis affecting the involved areas may occur at intervals for a number of years. These attacks are known as "delayed" or "deferred" reactions. They may closely resemble the primary reaction. Sooner or later these attacks cease altogether.

In other cases, as the final result of treatment, the nævus may appear too white, or the skin may become somewhat atrophic and telangiectasia may develop.

In still other cases, the site of the nævus may be slightly depressed. Sometimes a slightly increased tendency to freckling of the skin over the nævus may be noted.

We have never seen, however, any other untoward effects and in many cases these undesirable results that have been mentioned may be avoided

Fig. 4. Patient in figure 3, 9 years after removal of nævus with radium. Area of nævus is smooth and decolorized. Photograph, taken June, 1922, not retouched. Presence of freckles detracts from appearance of photograph.

altogether by a sufficient amount of care in carrying out the treatment.

THE TECHNIQUE OF RADIUM TREATMENT

A description of the technique of the application of radium and illustrations of a number of cases may be found in the author's book on *Radium Therapy* (7) so that many details of the method may now be omitted.

At the present time, in the treatment of angiomata we usually employ surface radiations, that is, radiations that are used directly over the surface of the nævus, the radium being applied closely to the skin or at a distance of a few millimeters or centimeters. In rare cases, emanation tubes may be introduced into the substance of the angioma. When the nævus is situated on the face and the cosmetic result of the treatment is very important, surface radiations are always used as the effect is more easily controlled. After a series of exposures has been given, it may be advisable in some cases to repeat the course of treatment in about 8 weeks. In other cases, a longer time may elapse between courses of treatment as subtle modifications in the appearance of a nævus that has been subjected to radium exposure may go on for many months.

In the case of very extensive nævi, it is sometimes difficult to avoid the production of a "checkerboard" effect. In these cases, we have resorted to the very simple procedure of outlining with ink, at the conclusion of an exposure, the area treated. This outline remains until the next exposure. We thus obtain an exact approximation of the edges of each area that is treated.

Overdosage must be carefully avoided, and indeed it may be stated as an axiom that nævi should never be subjected to doses that cause dermatitis, until selective, i.e., non-inflammatory doses have been found ineffectual. We have frequently seen vascular nævi made more unsightly by injudicious or excessive treatment.

We would lay special emphasis on the necessity of an adequate radium armamentarium which may be adapted to the requirements of individual cases.

From the standpoint of treatment, Wickham and Degrais divided angiomata into five clinical groups. These are:

1. Flat, superficial, vascular nævi, level with the skin. Certain types are known as "port wine stains." These usually disappear on pressure.

2. Flat, deeply infiltrating, vascular nævi, level with the skin. These usually cannot be made to disappear on pressure.

3. Raised, "hard," vascular nævi. These have a more or less sclerotic surface. Some are pedunculated.

4. Raised, "soft," vascular nævi. These tumors are sometimes pulsatile and erectile. The so-called "cavernous angioma" is a frequent type.

5. Deep, subcutaneous and submucous angiomatous tumors.

The different groups mentioned above merge into each other and several types may be present in the same individual or in the same tumor.

1. Flat, superficial vascular nævi. In the treatment of this group we would emphasize the great importance of avoiding inflammatory reaction.

In some cases, one may produce a very mild erythema of the skin. Erythema once produced should never be repeated. Severe inflammatory reactions may be followed by the appearance of unsightly telangiectasia although this event may be delayed for several years.

In our experience, no type of apparatus is so successful in this group as the flexible radium "toiles." Theoretically, a perfectly uniform action of radium on the skin can be produced by using a number of tubes according to the method described in the author's book on *Radium Therapy*. The practical difficulties, however, of using radium tubes in this type of nævus are almost insurmountable and in our opinion they should never be employed. No class of cases requires a more refined or skillful technique but in some cases a very satisfactory result may be obtained.

In other cases only a partial fading of the nævus can be brought about. If a faint rose color is finally obtained, treatment should be discontinued altogether for at least several years.

2. Flat, deeply infiltrating nævi. It is impossible to conceal nævi of this group when situated on the face by any of the artifices of the toilet, such as rouge, or powder. Radium treatment is therefore justified even though the results may not always be as perfect as could be desired. Even in the more unfavorable types a result can often be obtained that permits of concealment by various devices. In some cases, doses strong enough to produce a dermatitis must be used with the result that the skin eventually may become atrophic and telangiectasia may develop. In some cases, however, a very good effect may be obtained. In the treatment of this group we always employ the "toiles" or glazed plaques for producing inflammatory reaction.

3. Raised, "hard," vascular nævi. In this group, also, a mild inflammatory reaction must often be produced by the radium in order to level and decolorize the tumor. The presence of considerable connective tissue in the angioma renders the treatment of this type of nævus quite difficult. In some cases, the skin may have finally a smooth and somewhat shiny appearance which is not, however, unsatisfactory when compared with the original appearance of the growth itself. In some cases also, telangiectasia may develop. Usually the artifices of the toilet enable patients, if necessary, to conceal the treated area quite well.

In this group of cases, also, we always use the "toiles" or flat, glazed plaques for producing inflammatory reaction.

4. Raised, "soft," vascular nævi. In this group the results of radium treatment are most satisfactory. Large angiomata which may cover one-half of the entire head can sometimes be made to disappear without inflammatory reaction. In the treatment of this group, inflammatory reaction must be avoided if possible. Skillfully produced, the cosmetic effect in selected cases may be very excellent. In some cases, the treated area may have almost the appearance of the normal skin. In this type of angioma we employ either the "toiles," glazed plaques, or, in some cases, tubes arranged side by side.

In our opinion no other method of treatment can be compared with the use of radium in this type of nævus.

5. Deep, subcutaneous and submucous vascular nævi. In these cases it is important to place the radium at a considerable distance from the skin and to use relatively large doses. At the present time we use larger doses in the treatment of this type of angioma than we formerly employed. In this type of tumor we nearly always employ emanation tubes. In carefully selected, adult cases, 500 millicuries of radium emanation may be placed at a distance of 6 centimeters from the skin. A total exposure of 20 hours, divided into two or more periods may be given. In cases occurring in infants, 250 millicuries may be used at a distance of 3 centimeters from the skin for 10 hours. The exposure may be divided into two or more periods. With the above technique, no visible inflammatory reaction in the skin will result, but a marked effect may be noted on a deeply situated angiomatous tumor. In our judgment no other method of treatment is so successful as the proper use of radium in this type of nævus.

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A HEAD CLAMP STETHOSCOPE HOLDER

For the Rapid and Secure Adaptation of the Standard Bell Stethoscope to the Head

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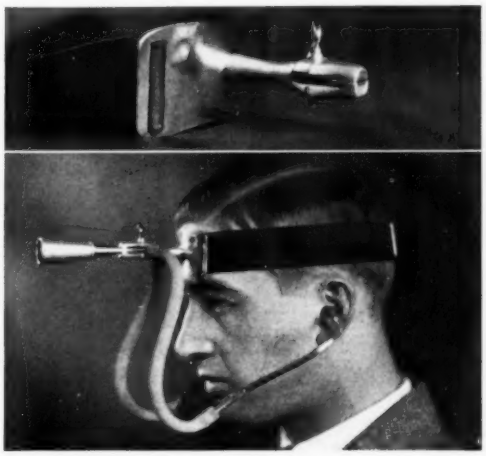
IN an endeavor to make the standard bell type of stethoscope serve the added rôle of "headstethoscope" in a simple, inexpensive, yet efficient manner, a head band and special clamp has been devised. It is adjustable to any of the standard Ford and Shephard types of instruments. A Bowles is less adaptable.

There is nothing new about the head band or frontal plate. The special clamp is rigidly riveted to the frontal plate and carries two molded jaws which grip the stethoscope bell at the bifurcation of its shank. A strong thumbscrew secures these parts in position. No change, whatever, is necessary in the stethoscope.

The device, designed primarily to make the standard stethoscope serve the dual purpose described, has some incidental merits:

The operator is permitted to employ his old instrument which alone fits his ears; the long tubes are no appreciable obstruction to his field of vision and the operator can wear glasses; his hands are free; the bell can be sterilized; and bone-conduction of sound is gained.



SUPRAPUBIC CYSTOTOMY AS A DIAGNOSTIC AND THERAPEUTIC MEASURE IN CERTAIN CASES OF RENAL TUBERCULOSIS[1]

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I BELIEVE it is rather generally accepted that tuberculosis of the urinary tract is primary in one kidney. This statement does not include tuberculosis of the seminal tract which should be considered separately, and it is made with the understanding that in a large percentage of cases, healed or quiescent or perhaps active tuberculous lesions may be demonstrated in remote parts of the body. I believe, too, that it is generally accepted that the treatment of renal tuberculosis is surgical, provided that there are no active, remote lesions, that the patient's general condition warrants a major operation, and that we can demonstrate that the other kidney is competent to carry the entire burden of renal function.

In the great majority of cases all these items can be accurately checked up by the ordinary means at our disposal: cystoscopy, ureteral catheterization, radiography, and the usual laboratory procedures. However, it is a fact that many, if not most, of the cases which come under our care have extensive lesions of the bladder: ulceration, contraction, limited bladder capacity, etc. This, of course, adds materially to the difficulty of cystoscopy, and many patients require repeated examinations, usually with some form of local or general anæsthesia. Occasionally a patient presents himself in whom it is absolutely impossible, because of limited capacity and inability to wash the field free of blood, pus, and tenacious mucus, to catheterize the ureters or even get a satisfactory view of the bladder. This, at least, has been my experience, and there have been three such cases out of a total of fifty-five cases of tuberculous kidney observed at my clinic at the Brooklyn Hospital during the past 5 years. One of these, the first of the three, following his fourth cystoscopy done in as many weeks, under prolonged general anæsthesia and with repeated irrigations, developed symptoms of urinary extravasation, and in spite of extensive and what appeared to be adequate drainage, died. The autopsy revealed the body of a young, well-developed adult; there was a small rent in the left posterolateral wall of the bladder at the bottom of a tuberculous ulceration; there was extensive extravasation of urine deep in the pelvis and extending up along the course of the ureter; the tissues were necrotic; the kidney on that side showed well advanced tuberculous lesions; the opposite kidney was perfectly sound, and careful search failed to reveal any other focus of tuberculosis in the body. This incident was tragic and deplorable, but it demonstrated rather emphatically to my mind that there is a mortality, small, of course, but nevertheless a mortality, attached to cystoscopy on tuberculous bladders. At any rate cystoscopy in such cases may assume the proportions of a major operation. Anæsthesia of some form is usually essential, and that item alone is not without risk. Any form of inhalation anæsthesia, particularly if prolonged or repeated many times, is of course, objectionable; spinal and sacral anæsthesia are not dependable, and local anæsthesia doesn't work. Given then such a case, in which after a reasonable trial two or more competent cystoscopists have been unable to perform a satisfactory cystoscopy, what shall we do in order to effect a complete urological diagnosis? It is true that a good roentgenograph will often give us a lead. Braasch has pointed out certain rather characteristic findings. However, they are by no means constant, and the X-ray certainly gives us practically no information about the other kidney. Subjective symptoms are often misleading. In one of the two cases reported below these signs pointed to the affected organ, while in the other case they pointed rather definitely to the healthy side. Before the development of the modern cystoscope, and I believe occasionally since that time, several methods have been suggested for the purpose of solving the problem; the segregator, laparotomy with exploration of both kidneys followed by immediate nephrectomy on the evidence thus obtained; lumbar incision on one or both sides with or without aspiration of urine from the renal pelvis; exposure of one ureter in the groin, applying a temporary ligature while urine from the other side is collected from the bladder, etc. In my opinion these procedures have but little to recommend them and much to be said against them.

In two cases reported below I performed a suprapubic cystotomy, passed catheters through the urethra, and guided them into the ureters through the open bladder, and in this way ob-

[1] Read at the meeting of the American Association of Genito-urinary Surgeons, Cleveland, Ohio, May 17, 1923.

tained all the information required. When the problem first presented itself to me I could find no reference to such a procedure in a casual survey of readily available literature, and felt that I was treading upon new and uncertain ground. In preparing this paper I had made for me by the Literary Research Bureau of the American College of Surgeons a careful review of the literature and found as usual that "there is nothing new under the sun." However, the references were few in number and a careful search covering the literature for the past 15 years developed only four articles published during that period. These were all by French writers.

Marion (1) in a clinical lecture published in 1912 recommends it. He credits Albarran as being the first operator to employ it. He notes the fact that it may be difficult of performance and also emphasizes the point that in addition to its diagnostic value it has the added advantage of putting the bladder at rest. At the conclusion of his address he catheterized through her bladder the ureters of a young woman. When he opened the bladder he found ulceration of the entire trigone and neck. In spite of this, catheterization was relatively easy. Contrary to his previous opinion it was the left and not the right kidney which was diseased. The ulcerations were treated with the thermocautery and the bladder drained. Left nephrectomy was planned for a later date.

Carlier (2) writing in 1912, considers this procedure of value in cases where it is impossible to catheterize the ureters in the ordinary way, and has employed it in certain cases. He cites two objections to it; that it may be extremely difficult, and that the suprapubic fistula may be slow in healing. He reports two cases requiring 2 and 4 months respectively. He prefers lumbar incisions, beginning with the supposedly healthy kidney, and immediate nephrectomy on the evidence thus obtained. Personally, I doubt very much if the information obtained in this way is, in any sense, conclusive or reliable.

Pasquereau (3) writing in 1912 reports one case in which he feels that nephrectomy alone would not have been enough to have relieved the symptoms. He catheterized the ureters through the open bladder which he found very extensively diseased. There was immediate relief of symptoms and nephrectomy was performed later. Following this he expected the suprapubic fistula to heal. It did not heal, and the patient was finally discharged with a permanent suprapubic drain. Both the operator and the patient seemed quite satisfied with this arrangement.

Cathelin (4) writing in 1918 states that in 50 per cent of the cases of renal tuberculosis it is impossible to catheterize the ureters in the ordinary way. He mentions catherization through the open bladder only to condemn it, citing as his objection the technical difficulties and the danger of a permanent fistula. He recommends as an alternative one of three measures: (1) the segregators; (2) lumbar incision with aspiration of urine from the kidney pelvis; (3) temporary ligation of the ureter on the supposedly diseased side, through a groin incision, and collection of urine through the bladder from the supposedly healthy side. With all due respect to Cathelin, I am by no means convinced of the wisdom of his choice of procedures. I believe that suprapubic cystotomy with catheterization of the ureters through the open bladder is entitled to a place as a diagnostic measure in certain cases of renal tuberculosis. I should entertain this opinion if it served no other purpose than that of a diagnostic procedure. There are, however, two other functions which appear to me to add materially to its value. First, it puts the bladder and the patient himself at rest and enables us to get him in better shape for nephrectomy later. A patient who is urinating every 20 minutes night and day, with each act of urination accompanied by pain, is not an ideal candidate for a major operation. Second, it gives us an opportunity to treat the bladder lesions locally, and perhaps in this way ameliorate and shorten the extremely protracted bladder convalescence so often noted after nephrectomy for renal tuberculosis. In my cases I swabbed the diseased areas with pure carbolic acid followed by alcohol. Other perhaps better methods might readily be suggested. These latter items lead me to feel that with a little more experience one might broaden the indications for this procedure to include not only those cases in which satisfactory cystoscopy is impossible but also those cases in which there is an extreme degree of vesical distress and in which cystoscopy, while possible, would be extremely difficult.

Four criticisms very naturally suggest themselves:

1. It is a confession of weakness and perhaps lack of cystoscopic skill. That may be true, and yet I believe that some of these cases will baffle the most skilful among us.

2. It is an added operation with added attendant risk. In my opinion cystoscopy may be and often is attended by quite as much shock and discomfort as is cystotomy and is not entirely devoid of risk and furthermore it does not always accomplish its aim.

3. The operation may be difficult or impossible to perform. I doubt if it should ever be impossible. The fact that it may sometimes be difficult is hardly a valid objection provided the procedure has merits. A minor point of technique which I have found of value is to have an assistant pass an endoscope with a light in the distal end, through the urethra. I believe that this provides better illumination than can be obtained by reflected light or light carrying retractors, and adequate illumination is an important factor in the operation.

4. That the suprapubic fistula will not heal. A consideration of this possibility is, of course, of extreme importance. And the merit of the procedure might well be decided upon this point. In one of my patients, the wound healed promptly and kindly. In the other patient the healing was protracted because of certain complications, but was eventually complete. It is my belief that while the closure might be delayed in some cases, all or certainly most of them will eventually heal. I believe that in those cases in which healing is delayed or in which a fistula might persist, the bladders would be so badly diseased that the symptoms persisting after nephrectomy would be almost if not quite as distressing as a suprapubic fistula.

There follows a very brief résumé of my two cases.

CASE 1. A male, aged 29, admitted to the hospital December 26, 1917. Patient had been in good health until February, 1916, at which time he passed blood in his urine. Since then he has backache, more particularly in the right loin. He has had dysuria and frequency, getting gradually worse until now he is urinating every half hour, day and night. He has lost 20 pounds in weight during the past year. Examination: The chest appears clear. The right kidney is palpable and tender. The left kidney cannot be felt. The urine contains pus, blood, and tubercle bacilli. During an observation of 26 days he was cystoscoped on four different occasions, twice with gas-oxygen anæsthesia. At no time was it possible to catheterize either ureter or to obtain a satisfactory view of the bladder. On January 21, 1918, a suprapubic cystotomy was done under gas-oxygen. The whole trigone and bladder base was covered with tuberculous ulcerations. These were swabbed with pure carbolic acid followed by alcohol. The ureteral orifices were readily located and a catheter was passed easily to the kidney pelvis on the right side. On the left side an obstruction was encountered in the intramural portion of the ureter but was passed with a little manipulation.

The suprapubic incision was partially closed in the usual manner with a rubber drainage tube in the bladder. Clear urine and normal 'phthalein were obtained from the right side; from the left side the urine was loaded with pus and tubercle bacilli and no 'phthalein was excreted in 1 hour. The relief from symptoms was immediate and striking. The patient had restful nights and gained rapidly in weight, color, and general strength.

On February 4 (2 weeks after cystotomy) a left nephrectomy was done. The kidney showed advanced and extensive tuberculosis. Operative convalescence was uneventful.

On February 12 (8 days after nephrectomy, 22 days after cystotomy) he was voiding most of his urine through the natural channel. February 16 (4 days later) the suprapubic wound was closed. On February 25 he was discharged, with a small sinus in the kidney wound.

April 1. Kidney wound is broken down throughout nearly its whole extent. He urinates every 2 hours by day and twice at night.

July 1. The kidney wound is closed. He is urinating every 3 hours by day and once at night. There is still pus in the urine.

February 20, 1919. Admitted to medical ward with a story of headache, chills, and fever, for 2 weeks. He reports that he has been very comfortable in so far as his bladder is concerned, except that he has been obliged to arise once at night. There is a suggestion of rigidity in his neck muscles. The cerebrospinal fluid shows a marked increase in cell count, and tubercle bacilli. Death occurred on March 6, 1919, from tuberculous meningitis.

While the end-result in this case was unfortunate, I feel it was no reflection on the procedures employed. The relief from symptoms in the interval between his cystotomy and his nephrectomy was most striking, and the rapidly progressive improvement in bladder function following his discharge from the hospital was very different from the tardy progress so often noted in these cases.

CASE 2. Male, 25, admitted to the hospital September 22, 1922. Family and previous history irrelevant. For the past year he has felt below par, tires easily, and urinates twice at night. For the past month dysuria and frequency, rapidly progressive. Nocturia: six. Two weeks ago, terminal hæmaturia. He now urinates every 20 to 30 minutes day and night. He has been cystoscoped twice in the out-patient department with indefinite findings.

Examination: There is dullness and bronchovesicular breathing over the right apex, extending to the third rib. There are no cough, no râles, no sputum. The chest lesion is evidently healed. Neither kidney is palpable, but there is some tenderness at the left costovertebral angle. The urine contains pus, blood, and tubercle bacilli. The Wassermann reaction is negative. 'Phthalein, 40 per cent. Blood chemistry: urea, 30; creatinin, 2.25; sugar, 114. Carbon dioxide combining power, 71.9. Roentgenogram shows the right kidney enlarged. The left kidney is not clearly seen. At the right side, just below the sacral promontory, apparently in the course of the ureter, there is a vague, indefinite shadow about 1 centimeter in its longest diameter. This suggests a ureteral calculus.

September 23, 1922. Cystoscopy under gas-oxygen anæsthesia. This was very unsatisfactory; neither ureter orifice could be seen nor could one get a very satisfactory view of the bladder wall, except to get the general impression that it was extremely ulcerated.

September 29, 1922. Cystotomy under gas-oxygen anæsthesia. There is extensive ulceration involving almost the entire bladder mucosa. This was swabbed with carbolic acid and followed by alcohol. The ureteral orifices were identified with some difficulty. A No. 5 catheter passed readily to the kidney pelvis on the right. A catheter will not pass on the left, and a fine probe was passed 2 inches into the left ureter, where it is definitely arrested.

A faint trickle of very cloudy urine is seen emerging around the probe. Wound partially closed with a rubber tube in the bladder. Urine from right side contains a few pus cells, no tubercle bacilli. Intramuscular 'phthalein appears from the right side in 9 minutes. There is no 'phthalein from the left side (collected from the bladder) in an hour.

The day after operation the patient developed an acute pyelitis on his right side, with chills and fever, and tenderness over the right kidney. This persisted, gradually diminishing, for 1 week. The following week he was very comfortable and occasionally slept all night.

October 13, 1922 (2 weeks after cystotomy). Left nephrectomy. This was particularly difficult. The kidney was double normal size, high up under the ribs, and very adherent. About 5 inches of much thickened ureter was removed with the kidney. It had been our intention to remove the entire ureter, but at this stage of the operation the patient was showing considerable shock and the ureterectomy was abandoned. Convalescence was rather stormy. Both wounds became badly infected.

December 4, 1922. There was a severe chill, and a temperature of 104°, scanty urine, and much pain and tenderness over the right kidney.

December 6, 1922. Total anuria.

December 7, 1922. Cystoscopy with gas-oxygen anæsthesia. It is of interest to note that on this occasion, in spite of his stormy time the bladder was sufficiently improved so that it was a relatively easy matter to identify and catheterize the right ureter. The catheter was passed to a point apparently near the sacral promontory where it met a definite obstruction. This was finally passed and there followed a gush of cloudy urine through and around the catheter. There then occurred a fairly prompt subsidence of symptoms, the temperature reaching normal 5 days later, where it remained. On December 9 a calculus was passed as noted in the roentgenogram.

Convalescence after this was uneventful. Discharged on January 22, 1923. Kidney wound granulating. He is voiding all urine by day, but there is a little leak from the suprapubic fistula by night. This was entirely closed 3 weeks later. The closure had required fourteen weeks.

April 2, 1923. Both wounds healed. Has gained 25 pounds. Is working. Urinates every 2 hours by day, twice at night.

Obviously this patient had a very stormy time, but I believe in spite of and not because of the methods followed. His complicating right ureter calculus and pyelitis were, of course, important factors in retarding his recovery. Notwithstanding all this I believe that he is further along with his bladder convalescence than he might have been had he been handled in a more orthodox manner.

CONCLUSIONS

In conclusion I submit for your consideration:

1. That in cases of renal tuberculosis where it is difficult or impossible to catheterize the ureters in the usual manner, suprapubic cystotomy is the method of choice for the purpose of making a complete diagnosis.

2. That because of certain therapeutic advantages made available by the procedure, increased experience may broaden the indications.

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EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

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MARCH, 1924

BRODERS' INDEX OF MALIGNANCY

FOLLOWING the removal of a malignant growth, the important question with regard to the permanency of cure arises in the mind of both surgeon and patient. In 1919, Broders, of the Mayo Clinic, described a method of measuring the degree of malignancy in neoplasms. He studied 2000 malignant growths, grouping them in four grades according to their degree of malignancy. The basis of the index depended on the fact that the more a neoplastic cell tended to differentiate, or in other words, to approach in structure a normal cell, the lower was the degree of malignancy; and likewise, the more malignant the tumor, the more undifferentiated or embryonic were its cells. The four groups were graded according to the approximate proportion existing between the undifferentiated cell and the differentiated cell. In a tumor of Grade 1 malignancy, about three-fourths of its structure contains differentiated cells and one-fourth, undifferentiated cells; in a tumor of Grade 4 malignancy, all the cells are undifferentiated. Between these two extremes are tumors of Grade 2 and Grade 3 malignancy. Grade 2 contains about one-half differentiated cells, and one-half undifferentiated cells; Grade 3 contains about one-fourth differentiated cells, and three-fourths undifferentiated cells.

The accuracy of this index of malignancy has been demonstrated by the end-results following removal of growths of the lip, skin, genito-urinary organs and cavities, and internal organs of the head and neck. From a review of the known cases of death from epithelioma of the lip, it was found that the mortality from this cause was 100 per cent in cases in which malignancy was graded 4, 84 per cent in cases graded 3, and 55 per cent in cases graded 2, while there were no deaths in the group graded 1. In other words, by grading tumors thus, Broders was able to form an accurate prognosis in cases of malignancy. Emphasis was placed on this by Percival Cole, late Hunterian professor of the Royal College of Surgeons of England, at a lecture delivered at the Cancer Hospital, London, in 1920. In general, however, the significance of this index of malignancy required almost 2 years to disseminate through the profession, and yet its value became apparent in widely separated centers at about the same time. Meleney in Pekin, Aureliano Urrutia in Mexico, and Brewer in New York, in writing on epithelioma, accept Broders' grading of malignancy as a law of prognosis. Urrutia in his monograph on *Hybrid Epithelioma* says of Broders' principle of grading malignancy: "The results of well proven facts will be the law which shall in the future govern the prognosis of cancer, over which we shall base our diagnosis, and which will prompt

the surgeon to perform, or not to perform, an operation." In the same vein, Meleney says: "This grading is the most significant work that has been done recently on epithelioma."

Work done by Martzloff, of Johns Hopkins, in 1923, substantiates Broders' work, in which the principle of cell differentiation as an index of malignancy, described by Broders in 1919, plays the most important part. Broders determined his grading of malignancy according to the proportion existing between the undifferentiated and the differentiated cells, and classified the neoplasms on a mathematical basis, whereas Martzloff, using Broders' principle of cell differentiation, classified his neoplasms according to the type of cell predominating. It is interesting to note that the classifications of epithelioma of the cervix by the two observers is so similar that one is impressed with the accuracy of the method, for in comparing the end-results following hysterectomy for carcinoma of the cervix, in which the most malignant type of tumor is concerned, the good results reported by Broders and Martzloff are almost identical.

WALTMAN WALTERS.

FRACTURES OF THE HIP

THE problems confronting the profession in the treatment of hip fractures are gradually being solved. The common use of the X-ray has afforded more accurate knowledge of the type of the fracture, and as a result many of the so-called strains and sprains heretofore unrecognized as incomplete or impacted fractures are properly diagnosed and treated. Such unrecognized fractures have, in the past, produced a considerable percentage of the coxa varas and non-unions demanding reconstructive surgery.

In recent fractures of the hip, the nearest standard of treatment is undoubtedly the Whitman method. It allows accurate reduction and fixation, but demands a knowledge of plaster-of-Paris technique. Pulmonary congestion and pressure sores are avoided by change of position, which may be accomplished painlessly once fixation has been accomplished. The use of an anæsthetic and of an orthopedic table is found a valuable aid in the reduction and application of the cast. It is advisable to carry the cast from thorax to toes on the affected side, molding it to the pelvis and leaving a large window over the abdomen and knee. When the cast includes only the pelvis, a double spica is advisable, carrying it down to the knee on the well side, and reinforcing it by a board just above the knees, over which plaster bandages are applied. Extreme abduction in extension with internal rotation gives practically anatomical reduction in fractures of the hip or epiphyseal separation. In extreme old age, and in cases in which anæsthesia is contraindicated, the treatment may be applied with very little pain if an orthopedic table is used; it is, however, sometimes best to accept the possible deformity rather than lose the patient by insisting on treatment. The surgeon should protect himself by further consultation, and by prognosticating a possible coxa vara or non union. The patient, once the cast has been applied, may be placed face downward, on the back, or turned on the side. To facilitate the use of the bed pan, a Bradford frame may be placed under the patient, and by means of ropes and pulleys attached to a Balkan frame and windlass, the body may be raised and lowered without discomfort. The areas over the sacrum and patella should be massaged frequently, and any pressure further avoided by change of position. Stiffness of the knee following fixation for several months, may be avoided if hinges are inserted on either side of the knee, and enough plaster

cut away behind to allow mobility. The duration of fixation in plaster should be left to the surgeon's judgment, although 6 months might be suggested as a minimum. A short spica cast, crutches, or a walking caliper during the early ambulatory period should insure against possible coxa vara or non-union. The value of repeated X-ray examination before and after reduction and during the ambulatory period, should not be overlooked.

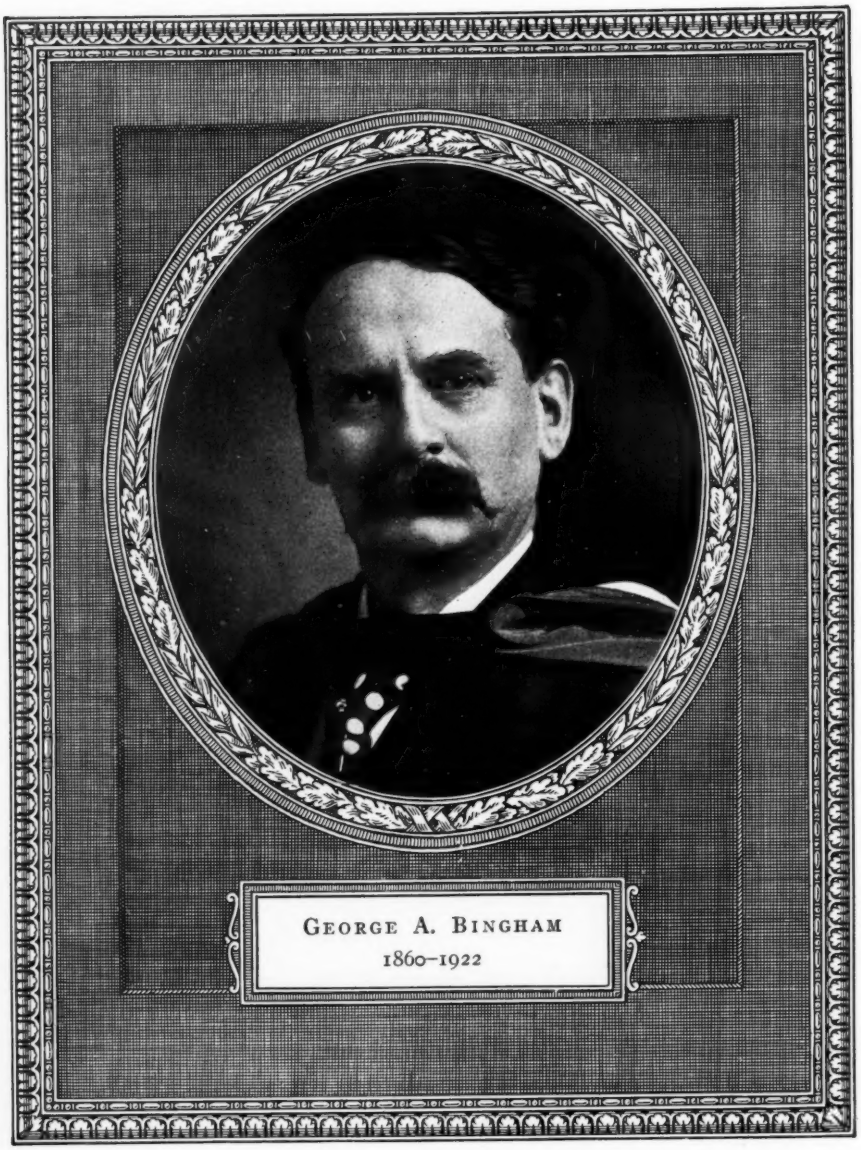
Coxa vara and non-union are often the result of too early weight bearing. Conservative treatment, once coxa vara has occurred, is of little value. Open operation, osteotomy and prolonged postoperative fixation, or traction in abduction is not always advisable, inasmuch as many of these patients are aged and weakened by previous confinement. It is often advisable to accept the deformity, and when recognized early, attempt to prevent its increase by means of a walking caliper or crutches and elevation of the shoe on the sound leg.

In cases of non-union, in a good surgical risk, the unabsorbed femoral neck may be satisfactorily treated by bone grafts. The graft should be strong and may be taken from the fibula or tibial ridge. After freshening the fractured ends, the graft is driven through a drill hole which passes through the trochanter, neck, and well into the head, with the leg in abduction, extension, and internal rotation. Thus the ununited fracture is held in the cast, just as is a recent fracture treated by the Whitman method; the graft, acting as a mechanical peg, aids fixation; it affords a means of blood supply to the head and is a living bone bridge stimulating bone growth. Further support consists of an osteoperiosteal graft passing around the ununited neck. The duration of fixation must be determined in each case by X-ray and clinical examination, great care being given during the early ambulatory period, when an abduction cast or walking caliper is used lest the graft be broken and failure result.

If non-union exists with absorption of the neck, the more recent operations of Bracket and Whitman are excellent.

When the former operation is employed, the remaining head is curetted out and the freshened distal end fitted into it by abducting the leg and obtaining fixation in a cast. The Whitman operation removes the head. The greater trochanter is best detached in both operations and sutured or nailed at a point lower, and opposite, the lesser trochanter. The postoperative care, following open operations, is essentially the same as following recent fractures.

With the full co-operation of the patient and sufficient time, the surgeon has before him the means of improving the rather discouraging results, that have been obvious in the past, in the care of fractured hips and their complications. H. W. MEYERDING.



GEORGE A. BINGHAM
1860–1922

MASTER SURGEONS OF AMERICA

GEORGE A. BINGHAM

THE writing of a biographical note upon the life of a dear friend, now departed, can never be an easy or a pleasant undertaking. It can only be a task, a melancholy duty, even if undertaken as a labor of love. It rouses regretful memories of days of pleasant association irrevocably gone, in the work of what was in its day one of the very best of the proprietary schools of medicine on this continent, Trinity Medical College, Toronto, when that particular stage in the development of medical teaching and in the production of a useful body of practitioners, was serving the public interest well, and paving the way for the advent during the past twenty years or so, of the still more developed type of teaching institution with which we have become familiar.

No one of the scores of teachers, in Canada and the United States, who have watched the transition, and borne a personal part in both the older and the newer systems, has filled a larger place, or served his day and generation more worthily in both, than the subject of this sketch.

Like very many of those in his chosen profession who have come to eminence in it, Bingham came of sound Old Country yeoman stock. He was born in Durham County, in the Province of Ontario, on August 28, 1860, the son of William and Elizabeth (Mills) Bingham, of that Irish Presbyterian stock which has done so much for the other lands to which it has migrated. His early education was in the public schools and in the high school of his own county, in Bowmanville, Ontario. After qualifying as a public school teacher at the normal school, Toronto, he served as head master for two years in the public school of Harriston, Ontario, then entered Trinity Medical College as an undergraduate in 1880, and after a distinguished course, graduated in 1884, both in Trinity University as M.D., C.M. and in the University of Toronto as M.B. After some postgraduate work in New York, and a brief period of practice at Manila, Ontario, near his old home, where he promptly became a great favorite in his new career, he returned to Toronto at the request of the late Dean Walter B. Geikie, M.D., of his old school, to begin his career as medical teacher in the dissecting room of his Alma Mater. From 1884 to 1889 he was demonstrator of anatomy. In 1890 he became professor of practical anatomy, and in 1892 professor of surgical anatomy as successor to Dr. Luke Teskey.

It was in this chair that his pre-eminent ability as a teacher came to be fully known. His capacity in correlating the needs of the surgeon with the facts of anatomy, and the facile vivid skill with which he set his knowledge before the minds of his classes, will not be forgotten by anyone who had the good fortune to be trained by him, for he always displayed to the full that prime qualification of the wise teacher, the ability and the will to place himself in the position of those whom he was teaching, to appreciate both their needs and their difficulties, and the present state of their knowledge as well as their future requirements.

He became later professor of clinical surgery in Trinity Medical College, and in 1903, upon the amalgamation of the medical faculties of Trinity College and the University of Toronto, was made a professor of clinical surgery in the new faculty of the University, and chief of one of the surgical divisions of the reorganized Toronto General Hospital, which position he was filling, with the utmost satisfaction to all concerned, at the time of his death.

He had held for years, before the amalgamation of the faculties, surgical appointments on the staffs of St. Michael's Hospital, The Toronto General Hospital, and the Hospital for Sick Children, in each of which he had been advanced till he held the position of full surgeon in 1903, transferring his whole services to the staff of the Toronto General Hospital upon its re-organization.

Apart from his outstanding capacity as a teacher, mention should be made of his qualifications as a surgeon. Physically he was strikingly fitted for his work. His strong, well balanced presence, his handsome massive head, and thoughtful cheerful countenance, his quiet unassuming air of confidence and power, his dignified kindly demeanor, always attracted both patients and students. He was never known to be mean or narrow or "top-lofty" in his outlook upon life or his relationships with his colleagues. He was never the mere operator, but always the wise bold conservative and sympathetic surgeon, with the mind of the physician as well. His sound early education had given him, as all good education does, a love of good literature, and this with his natural gift for self-expression, made him an excellent speaker. Very few of his confrères were his equal in the art of public speaking, for he had ideas, and was clear, accurate, and even eloquent in presenting them to his audiences.

Outside of his professional work, he took a wide interest in the various medical organizations of the city and beyond. He was for some time a member of the senate of the University of Toronto, and was a charter member of the Academy of Medicine of Toronto, and a past president of the Æsculapian Club, of the Toronto Clinical Society, and of the Ontario Medical Association. During the two years before his death he had done very much, by extensive travel and addressing of medical audiences, both in the Western Provinces as far as British Columbia and in New Brunswick and Nova Scotia in the East, to bring new strength to the Canadian Medical Association and its Journal.

His lamented death occurred on March 1, 1922. His health had been for some months indifferent, and he was on the point of acceding to the urgent advice of some of his confrères to give up his winter work and classes and go south to recuperate, when on February 9, he fell ill with a sudden pneumonia. The disease, though severe in onset, ran an unexpectedly favorable course, till after an early pseudo-crisis symptoms of exhaustion developed ending in coma and death.

His last thoughts were of his classes and his work, even as his students had always held first place in his sympathy and friendships. His best monument is the place he holds in the respect and affections of countless hearts now scattered over all parts of Canada and the United States, and in Mission Fields and in Public Services in all parts of our widespread Empire, and outside it as well.

His funeral service was held in Convocation Hall at the University he had served so well, and lectures were suspended for the day, in respect to his memory.

J. T. FOTHERINGHAM.

TRANSACTIONS OF SOCIETIES

CHICAGO GYNECOLOGICAL SOCIETY

REGULAR MEETING HELD NOVEMBER 16, 1923, DR. BACON, PRESIDING

SYMPOSIUM ON OBSTETRICAL TEACHING

DR. C. S. BACON, CHAIRMAN: The program committee has taken as the first program of the year a symposium on obstetrical teaching. Is there anything wrong with obstetrical teaching? If so, what is the matter and how can it be corrected?

This subject is of importance because of the recent development in schools, in prenatal and postnatal clinics, and because of papers on reform in obstetrical teaching presented by well known authors.

The fifth year clinical work adds a feature that has not previously been considered. This fifth year has come to be recognized as one of the most important years and we are obliged to consider what teaching is done in the hospitals where the fifth year work is given.

So we invited to participate in this program the deans of faculties, heads of departments, and chairmen of fifth year committees. The chairman and secretary of the Committee on Education of the American Medical Association were also invited but could not be present.

DR. HILLIS will give a more or less general introduction to this subject:

The United States government has recently enacted a law which has for its purpose an improvement in the practice of obstetrics.

This new statute, the Shepherd-Towner law, was passed without the support of the organized medical profession. Many states have appropriated money which is necessary to participate in the operation of the law. Certain states have refused to participate as a result of the active opposition of local medical societies.

These facts indicate a widespread dissatisfaction with obstetrics as it is now practiced. This opinion is not shared by the medical profession as a whole.

The opponents of this legislation have urged against it states' rights, bureaucracy, paternalism, and as tendency toward state medicine. These arguments have been advanced without investigation of the possibility that there may be some justification for the implied citicism of the law.

A recent survey made in the state of New Jersey comparing the results in confinements conducted by midwives with cases delivered by doctors leaves much to be desired from the standpoint of the physician.

A number of years ago Williams investigated the teaching of obstetrics in this country and concluded that instruction in this branch of medicine was not on a par with that in other departments. Since that time many of the faults he found have been corrected and in the class "A" medical schools the subject is usually allotted a sufficient amount of time and the didactic work is given in a satisfactory manner. But obstetrics cannot be learned from books.

In some of the larger hospitals in Chicago some of the internes have no experience in the obstetrical wards. In the Cook County Hospital only twenty-four out of the sixty-six internes have any obstetrical service.

The fifth year committees in three of the larger medical schools of this city certify these hospitals for fifth year work and take no special cognizance of the obstetrical experience obtained by the students in the smaller hospitals.

It is believed that an inquiry into the amount of clinicalal teaching, given at the bedside and in the labor room will indicate a deficiency in this most important method of instruction.

If it is true that there is need for more efficient obstetrical teaching, a movement in that direction would be inaugurated most appropriately in this society.

DISCUSSION

DR. ERNEST E. IRONS, Rush Medical College: The out patient department, if properly managed, affords invaluable opportunities for clinical teaching. The head of each department should be familiar with this work. Those departments are most successful in which the head of the department actually does regular work and is a regular attendant in the dispensary.

The need for hospital beds differs in the special departments of a medical school. A smaller number of beds is required for such departments as the ophthalmology department than is required for the general surgery department. Each of the departments should have available a definite number of beds for the study of cases.

Most of the teaching in obstetrics has been done heretofore through the out patient department with very few beds available in the college hospital. This means that sufficient pathological cases were not

available for the instruction of the staff as well as the students, and the head of the department had difficulty in building up his department.

There should be an increase in beds devoted to obstetrical patients.

DR. N. SPROAT HEANEY: The public are demanding better medical education and better obstetrical service. I was recently in a small town in Illinois and was interested to hear the doctors say that the people are demanding more hospital accommodations for obstetrical work. There is a greater demand all the time for hospital space for delivery. Patients are coming for urine and blood pressure examinations and these country doctors are beginning to wake up. They are asking obstetricians to read papers on obstetrical subjects; they want to know how to do obstetrics. It is all very encouraging.

As I look around the audience tonight it seems to me that we have here one solution of the problem with regard to obstetrical teaching. Except for Drs. Brown, Irons, and Elliott, I don't see anybody except those who are here usually, the obstetricians. We need help from the other departments in our medical schools.

Obstetrics has been the stepdaughter of medicine. In the old times each man put a thousand dollars into the medical school and the biggest man with the strongest pull taught surgery. The next man got medicine or eye and ear, and the last man was some general practitioner invited in who, without being charged anything for his stock in the medical school, got to teach obstetrics. Nobody was ever interested in his teaching, and no beds were assigned him in the hospitals because the wailing might disturb the surgical patients.

The professors of surgery and of medicine today were raised on that sort of "pap," and that is the attitude they have now toward obstetrics. You know how willing they all are to refer an obstetrical case if it does not require cæsarean section.

A lot of our present difficulty with obstetrical results is due to the fact that men have been taught in the out patient department with the lowest interne on the obstetrical staff as a teacher.

Usually the only clinical teaching that the heads of obstetrical departments do, except for the demonstration of some pathology in pregnancy, is either a cæsarean section or some difficult forceps case. And that is not the kind of teaching that the students need. They need the ordinary cases, to become familiar with normal cases and slight deviations from the normal.

DR. JOSEPH B. DELEE, Northwestern University Medical School: Is the mortality and morbidity of obstetrical practice in the United States as great as the proponents of the Shepard-Towner bill have led the public and some of the medical men to believe? And, are the midwives doing better work than the doctors?

And, if it is true, that the mortality and morbidity of obstetrics are both so high, why *are they so high?* Why jump on the teaching as the single and only cause of the high mortality? There are other reasons to my mind, much more fundamental than the teaching, that causes the present deplorably high mortality and morbidity. It is the disrespect, the disappreciation, the disappraisal in which obstetrics has been held from time immemorial. It was considered a disgrace for a man to go into obstetrics.

Up to the year 1850 a man who did obstetrics was not permitted to join the Royal College of Surgeons in London. And if a member of the Royal College of Surgeons was seen talking to an obstetrician on the street his resignation was requested.

I would suggest, as the outgrowth of this meeting, that a committee be appointed to investigate the causes of the present high mortality and morbidity in obstetrics.

Some years ago I was chairman of a committee appointed by the American Medical Association to apportion, in a standard curriculum for medical schools in the United States, the amount of time to be devoted to obstetrics and gynecology. When we made our first lists for all the subjects, we found we would need 8 years of a student's time working 9 months of the year every day including Sunday in order to teach him as much as we thought he ought to know. We finally compromised on 4,000 hours and this number has been reduced since.

Some of the reasons for the inefficiency of our teaching are preventable; some are not. A man wants to do cæsareans and forceps and see pathological conditions. It is very difficult to get enough material together in one place so that it will pay a man to go and see it. Therefore, we need better obstetrical hospitals. This is up to the public.

If the people, instead of bothering about a Shepard-Towner bill, had got together to see that teaching hospitals were provided they would not need any Shepard-Towner bill.

At the Northwestern University Medical School the work in obstetrics is given in the senior and junior years. Even in the second year some of the men get a chance to see obstetrical cases. The didactic teaching of the 2 years is divided among the six teachers. The class is divided into sections. The juniors and seniors are divided into three sections of about twenty-five each. The teachers alternate, changing each semester to the junior and the senior classes. The teachers use, in addition to the book, specimens and pelves. There are two lectures a week, that is, in two years 120 hours.

Of the manikin work each student gets from 18 to 24 hours in classes of six to eight. The senior class is divided into groups of six or eight, and these are drilled on the manikin. All operations that can be done on a manikin are rehearsed over and over again.

We offer no required laboratory courses in obstetrics, but we have an optional course. It is given by a man who is schooled in obstetrical pathology. That is not very well attended. The men have more than they can do otherwise. We don't emphasize as much perhaps as we might the laboratory side of obstetrics. We emphasize the practical side.

Northwestern has always striven to develop practical men, men who could be turned loose upon the public with safety.

While we would like to give more pathology than we are giving in the regular course, still we don't insist so much on the laboratory work.

The practical work we offer the students requires an attendance of two weeks at the dispensary where they take this much maligned teaching which Dr. Heaney condemned. I consider the out patient obstetrics an essential and invaluable part of the general scheme. I would regret very much to see the dispensary work taken out of our curriculum.

Done as we do it, I am convinced (and more convinced every year by the praises of the men who come back after being out 15 or 20 years) that the out patient teaching is really the most important individual portion of our teaching. They say that at the old dispensary on Maxwell Street they learned how to take care of the cases in the home, where the majority of babies are born.

We have had men that are hospital bred who are paralyzed when put up against an obstetrical problem in a shed or shack or barn. The men we turn out can handle obstetrics very satisfactorily without any sterile towels, without anything but a couple of sterile basins—they don't even have to be sterile—and with a few pairs of gloves and a mason jar full of cotton. We have a definite technique which is in printed form and supplied to each man so that the traditions of the founder of the dispensary are handed down.

In addition to the 2 weeks' practical work in the dispensary, the Northwestern students, and also those from the University of Illinois who take this course, are entitled to a week's observation in the hospital. The University of Illinois has not granted the men leave for more than 2 weeks so that we get very few of the Illinois men over at the Lying-in. But a large number of the Northwestern men spend the extra week there; 2 weeks at the dispensary and one at the hospital.

In addition to that, the students are invited up to the hospital for special cases. We have prenatal clinics and prenatal work at the Maxwell Street Dispensary. They see forceps cases, versions, perineorrhaphies, and postpartum hæmorrhage. They know how to prevent infection in hospital and dispensary service.

If those men we graduate don't practice obstetrics which is safe, it is not out fault. I know there are a great many hospitals and teaching institutions in the United States that give just as good work as we do. I know the other hospitals may give it differen ly but they give it just as well. So the fault is not entirely with the teaching.

DR. BERTHA VAN HOOSEN, Loyola University: Our obstetricians do not appreciate that the gateway to obstetrics is through the surgical door. Every obstetrical case is surgical. Every surgeon feels that a curettage in the kitchen is a disgrace. But no obstetrician feels that the delivery of a patient in a home is not fine. I think that obstetrics must be hospitalized because it is a branch of surgery.

One of the reasons why the women are up in arms, and perhaps the reason we have the Shepard-Towner bill, is because women are tired of seeing their daughters and their sisters suffering. We should pay more attention to anæsthesia in obstetrics.

I think anæsthesia is an absolute necessity, not only for the best teaching, but to satisfy the great demand of the public for painless childbirth.

DR. HEANEY: Why, if obstetrics is valuably taught in the home, should not the teachers of internal medicine and surgery take up teaching in the out patient department and show the students how to attend cases of pneumonia in the home for the sake of adapting home conditions to the needs of their cases in future practice?

DR. DELEE: Feeling so keenly the value of taking care of the patients in the home, I have recommended to our medical department that they establish an out clinic for medicine. I do not want to be on record as opposed to the hospital movement. But, gentlemen, you have to meet conditions as they are and not as they should be.

Ninety-five per cent of the babies are still being born at home and not in the hospitals.

DR. HEANEY: They will be as long as that is taught as an ideal method.

DR. DELEE: That is simply a transition point. If students were taught how to do appendix operations in the kitchen the mortality would be reduced throughout the United States.

DR. C. S. BACON: In the University of Illinois we give 200 hours to obstetrics beside the intensive work of 2 weeks when the students are at the Lying-in Hospital Dispensary, or at one of the affiliated hospitals. Half of the 200 hours is given to didactic work, half in the third year and half in the fourth. This work is again subdivided. There is lecture work of 32 hours and 64 hours of quiz work. The labors are conducted to quite an extent by the interns. That is the weakness of our system. The hospitals affiliated with our schools, where the majority of our fifth year men work, have a certain amount of supervision. In one of the hospitals we have about a thousand cases a year. Each man has an opportunity of having delivered under his personal supervision about 125 cases. I feel that most of these interns can be trusted with ordinary cases.

Even the cases they see where great mistakes are made in delivery are not without some value because they are not debarred from making criticisms and learning from the mistakes that they see.

DR. IRONS: As you all know, I am very recently acting as dean of students, and so it is obvious that I can't offer very much in constructive statements. I remember with a great deal of pleasure the course of obstetrical teaching I had with Dr. DeLee. We all struggled for a chance to go to the Maxwell Street Dispensary.

I would like to ask Dr. DeLee two questions. Having in mind the opportunities for teaching as he has

described them in instruction of the students, would he feel that additional teaching of the hospitalized cases would be desirable?

DR. DELEE: Yes.

DR. IRONS: And if so, to how great an extent?

DR. DELEE: I think if they have 2 weeks in the hospital and 2 weeks in the dispensary they are well taken care of.

DR. IRONS: I would like to ask Dr. DeLee whether in his opinion the instruction of students by the internes in the out patient department is a satisfactory way of teaching students?

DR. DELEE: No. It is not fully satisfactory but it is the best we can do at present.

DR. IRONS: Assuming that each class consists of one hundred men and assuming that hospital teaching is desirable to a greater extent than it is offered at the present time, how many beds would be required?

Should all primiparæ be hospitalized for their first delivery?

DR. DELEE: The minimum would be 100 beds. I would say a bed for every student.

DR. HEANEY: One hundred beds was the answer I got in every place I asked. At Sloane and the Brooklyn Lying-in, they don't allow any woman to receive out patient attention if she is a primipara or if she had a pathological delivery or pregnancy the last time.

DR. DELEE: I think there might be some value in the argument in having the primiparæ delivered at the hospital, because pathology is more common in the primipara. If you leave her the way she should be, she is a primipara all the time. The fact that a woman becomes a multipara is rather a confession of error in our practice.

I think, however, that with our system at the dispensary we can deliver a large number of primiparæ safely at home.

I want to say there are dangers in hospitalization. The Metropolitan Life Insurance Company collected two thousand cases taken care of by the Maternity Center of New York, traced them to their homes and found that the highest mortality was in those cases that went to the hospital for delivery. The women who were delivered at home and had doctors and midwives at home had the lowest mortality. That is well worth thinking about.

DR. IRONS: I would like to ask Dr. DeLee whether there would not be a selection in those cases.

DR. DELEE: Just the women who attended the prenatal clinics.

DR. HEANEY: When a hospital is accepted as a proper place for a man to spend his fifth year, what qualifications do you ask from their obstetrical department, if any?

Comparing the difficulty of teaching pathology in obstetrics, what percentage of all eye infirmities that a general practitioner in the country will ever meet in his lifetime is required to be in the hospital?

And how essential is it that pathology be taught in a hospital to men who are going to be general practitioners? Ambulatory cases coming to the dispensary cannot be thoroughly taught without having a single hospital bed; and, in your opinion, can obstetrics be taught that way?

DR. BACON: The university has members of its obstetrical staff on the staff in each affiliated hospital. These men have a certain voice at least in the teaching and are expected to have the chief say in regard to the teaching of obstetrics in those hospitals.

It is true that many of our students take their interneship in other hospitals not affiliated with the university. There we have to accept the hospitals that are accepted by the American Medical Association and by the committee that we have in the city of which Dr. Elliott is the chairman. This committee is trying to bring about some uniformity in the standards of hospitals to which we have to send our students.

DR. HEANEY: Is it not true that hospitals are accepted as accredited when they have no obstetrics whatever.

DR. BACON: I am sorry to say that is true.

DR. E. V. L. BROWN, University of Illinois: The situation in which you find yourselves as obstetricians is practically the same as that in which men in all other fields find themselves—lack of adequate quarters, material and men. One of the organization evils is our separate isolated hospital which has no integral relationship to the general hospital, to the medical school or to the university. The same type of individualism is found in England and France in contrast to the institutional centralization found in Germany and Austria.

Our universities will probably soon completely dominate medical education, and with it, the fifth year, as they now do the first four and will provide and control the physical properties, the staff, the material, and the teaching done. A possible year could include three months each in medicine and surgery, two months for obstetrics, gynecology, orthopedics and dermatology, one month for eye, ear, nose and throat. This division is only suggested to show that all branches can be covered though, of course, very inadequately.

DR. ELLIOTT: I am quite sure that we do not know exactly what we are aiming at in undergraduate medical education. At the end of 5 years the student is not a finished product. He cannot be a competent obstetrician any more than a competent internist or surgeon.

The fact mentioned tonight that people are becoming more accustomed to hospitals for obstetrical care offers a possibility of satisfactorily solving one of your problems in obstetrical practice. In my relatively short experience I have noted a marked increase in the percentage of obstetrical cases, both normal and pathological, that go to hospitals. If it is true as stated that the mortality rate in obstetrical practice in hospitals is higher than that outside the hospitals there must be some other reason for it than the mere fact that they were hospitalized.

To my mind women should not be confined in the home any more than surgical operations should be performed there.

DR. IRONS: May I take exception just a moment? I think we have a very definite ideal in medicine and that is the training of good general practitioners in medicine.

I think the student should be better prepared in obstetrics than in surgery or medicine. He should be able to do special obstetrical work because he has got to deliver those women. He has got to do it properly and carefully *now*. He ought not to be doing surgery, nor setting himself up as a consultant in medicine within his first five years of practice, at the least.

It is obvious that a man going out into the practice of medicine should be able to deliver a woman in confinement. I assume that a man to start in the practice of medicine, if a general practitioner, should be able to do this. But he should be able to take care of pneumonia properly or be able to set a leg properly.

DR. MCGUIRE, Loyola University: I had my medical education in Dublin. We did not get a third of the didactic training abroad that you do here. The first six months every detail in conjunction with the patient's physical condition was supposed to be noted with the eye. We had to make our diagnosis by the touch of the hand, by getting a mind picture. We were especially prepared for our final examination. This examination lasted anywhere from ten to fifteen days of six hours a day. The examiners were taken from strange universities.

Our obstetrical training consisted of six weeks of interneship in a hospital, with a wealth of clinical material. We also had three months service in the out patient department. There was a didactic course in obstetrics in the morning for those six weeks. The whole object of the institution is to train practical men.

At Loyola we are trying to get fifty beds, if possible, at the dispensary of the school. We should have a six weeks course and those men should have an intensive obstetrical course combined with pediatrics. We will try and give them some deliveries on the outside if we can. We used to consider that if a man could get 20 or 25 deliveries, preferably under supervision at the hospital, his training was better than if he were let loose in the out training department doing normal deliveries alone.

DR. BACON: Dr. Lee is chairman of the committee on prenatal clinics that was organized under the supervision of the Health Department.

DR. W. G. LEE: Regarding the prenatal clinics: There is at the present time an increased recognition of the value of early examination of the pregnant woman.

Prenatal clinics have been started, largely from a recognition on the part of a few, that many cases first seen at labor were in much more serious condition than if early knowledge had led to prophylactic treatment.

Prenatal work in this city has been started at several different hospitals. Although a number of hospitals have started them, some only take care of the cases that they later will deliver, so it seemed fitting that others having also an educational function should take care of the people at large, wherever labor was to be conducted.

The Department of Health has established two or three centers. It is now the desire of this Department to have additional centers established in regions not covered otherwise, to have the technique uniform and on a high plane and to try to have all prenatal work follow the same general course with similar history charts so that all centers may benefit from the work of any individual one.

The Advisory Prenatal committee has been working along this line, there being on this committee representatives from the different medical schools. They thus are attempting to see that the poor have an opportunity to receive the advantages of skilled early attention; to have these patients go to hospitals where they may be available for teaching purposes; and to have them reach the proper hospital for their particular race, color or religion. This work is an aid in the gathering of statistics. Thus necessary charity work so supervised can be sifted out from work that should not be handled by charitable institutions.

To revert now to the general subject of tonight's meeting: The County Hospital staff passes in review the highest results, as it were, produced by our medical schools, because the "County service" is sought after by the graduates of all the schools, and is awarded by competitive examination.

I think the feeling there is universal that obstetrical training of the medical students "making County" is quite inadequate. We can only wonder, if this is the case with those who represent the highest attainments of our medical schools, what deficiencies would be revealed in the lower stand men who are not able to make a place by this competitive examination.

DR. JOSEPH L. BAER, Director of Prenatal Clinics of the Infant Welfare Society: In a small way I can offer a concrete example of the difference between undergraduate teaching in Chicago schools and schools elsewhere. Michael Reese hospital is reserving not to exceed four interne positions for out of town men. Of the four men who came in from out of town schools in this past year, each coming from a Class A school, 2, within 3 months, were so dissatisfied with our junior service that they wanted to quit. And the reason was that they were doing work now as junior internes that they had been doing as third and fourth year students in the schools from which they had come. And yet for years our local graduates have been competing rather eargerly for the Michael Reese interneships.

Our college undergraduates, in their third and fourth years, are wasting much of their time on the benches and are not getting bedside training. That applies particularly in obstetrics.

I believe that the fundamental fallacy in home delivery teaching of obstetrics is that it is second best. For twenty odd years here in Chicago the Lying-in service has given a home delivery teaching so well that the importance of hospital teaching in obstetrics for undergraduates has not been realized. I believe that the fundamental place for the teaching of obstetrics is in the hospital. I grant you there may be a very desirable place for out patient teaching, but only as second best.

Answering Dr. Irons' question about the primipara being delivered in the hospital, I firmly subscribe to the Sloane procedure. Not only primiparæ but multiparæ with a pathological history should, whenever possible, be hospitalized.

Dr. Bacon asked me to speak on prenatal development. There is no doubt that here is where obstetrical teaching should begin. The student who is taught to lay on a forceps is being taught the superstructure of obstetrics. He should be taught to measure and to palpate, to recognize disproportion long before labor sets in, to recognize toxæmias and accidental complications. The prenatal clinics should be utilized as teaching centers. The obvious place for this is in connection with the school.

I believe in really teaching our students obstetrics. Those who are teaching the student to examine by the rectal route rather than the vaginal route are sorely handicapping their students. I believe that in well regulated institutions and likewise in the home under proper conditions the vaginal examination is absolutely as safe as the rectal. The student will learn what he needs to get—the state of the cervix, the position of the head and the state of the pelvis from within.

Dr. Danforth: I think that you men who are in charge of the fifth year committees and who are deans of schools and who have to do with the placing of internes, should do something to make it clear to those who manage hospitals that a certain amount of practical work is essential for your fifth year student. A certain number of free cases should be provided.

We are hampered in getting enough cases for them to deliver themselves because the lay people who run hospitals do not know what students need. They won't know until it is borne into them by a sufficient expression of opinion. We must get home to them the fact that we owe these internes a duty; and if we don't perform that duty, we are failing as a source of instruction.

Dr. Fitz-Patrick, Member of Examining Board of the State of Illinois: The fifth year requirement, now written into law, makes it incumbent upon the hospital staff to organize and give special and satisfactory instruction to the internes, or be denied recognition by the Board of Medical Examiners. This, compelling them to hire resident physicians at considerable expense, based upon the experience of Pennsylvania where the compulsory interneship has been in force for the past seven years, will not be tolerated by a Board of Trustees with a deficit on hand which could have been lightened by staff cooperation.

The fifth year requirement will materially assist the valuable work so ably undertaken by the American College of Surgeons and later by the American Medical Association in their efforts to establish a standard for hospitals.

Dr. DeLee: I would resolve that the Chicago Gynecological Society appoint a committee to investigate the causes of the present high mortality and morbidity in obstetrical cases in the mother and the baby.

Is it entirely due to lack of good teaching? Is it due to the inherent difficulties of practicing obstetrics; to the hospitalization of cases, to puerperal infections in hospitals, to the greater frequency of performing cæsarean section, to the fact that general surgeons are doing obstetrics in the extreme cases, or to the general higher valuation of the baby's life which impels the accoucheur to attempt operations dangerous to the mother?

The above motion was carried and the committee appointed.

Dr. Heaney: I should like to have a resolution passed that a committee be appointed to investigate the causes of fetal and maternal morbidity and mortality; and a second committee, to investigate the relative importance of obstetrics in the medical curriculum.

The motion was carried, and the committees appointed.

THE SURGEON'S LIBRARY

OLD MASTERPIECES IN SURGERY

By ALFRED J. BROWN, M.D., F.A.C.S., Omaha, Nebraska

THE SURGERY OF ALBUCASIS

WITH the fall of Graeco-Roman civilization at the beginning of the middle ages, the germ of that civilization with its culture and learning was transferred to the Arabians and by them fostered during the period. To the Arabians and other Orientals we are indebted for preserving medical science, among other sciences, and keeping it alive to be handed back to bloom again in an occidental civilization with the Renaissance. During the middle ages the Hippocratic and Galenic systems of medicine were the most important and but little was done to add to them. However, the period did see the birth of the separation of medicine and surgery—though both were practiced, not to the same extent to be sure, by the same individual.

The latter part of the middle ages produced Chalaf ben Abbas Abul Casim el Zahrewi (Albucasem, Alzaharavius, Albucasis) of Elzahara (Zahera) near Cordova, who was a Spanish-Arabian physician born 936 and died 1013. His compendium ("Altasrif") was mainly copied from the medicine of the Greeks but the portion devoted to surgery was an advance over Graeco-Roman methods. This surgery, translated into Latin, was first printed in 1497; the second edition, here illustrated, was published by Bonetus Locatellus for Oct. Scotus' heirs, Venice, 27 Jan. 1500.

The surgery consists of a prologue and three main parts. In the prologue Albucasis emphasizes the value of surgery and dexterity with the hands. He speaks also of the necessity of a knowledge of anatomy. By citing examples of improper surgical handling of cases he emphasizes these points.

The *Surgery* proper consists of three parts: (1) The use of the cautery both actual and medicinal; (2) operations with the knife and exploratory puncture—venesection, removal of foreign bodies, principally arrows, etc.; (3) reduction of fractures and dislocations and the cure of sprains.

The cautery appears to be a cure-all and is indicated in nearly all diseases which are considered in the realm of internal medicine. For each part of the body and for each disease a different form of instrument seems to be indicated and the shapes of the cautery blades are many and varied. The indications for the use of an iron cautery are distinct from those for a gold cautery and of the two the gold is stated to be the more difficult to use. The actual cautery is advocated as more simple, and capable of less harm than the medicinal. As to its general indications, it appears to be useful for everything—headache, toothache, apoplexy, epilepsy, melancholia, ozæna, and diseases of the eyelids (in which both the actual and medicinal cautery are used). It is also advocated for pleurisy, dropsy, hæmorrhoids, fistula in ano, sciatica, and as an adjuvant in fractures and dislocations. Hernia is treated by reduction of the mass and cauterization, being careful the intestines do not escape. The patient is kept in bed 40 days and then convalesces for 40 days more. He excises cancer with cautery. The cautery is also recommended for hæmostasis. For each of these uses most careful detailed directions as to the use of the instrument are given together with a drawing of the form of the instrument to be used. In some diseases, the number, size and shape of the spots to be made on the skin are illustrated. The use of the cautery takes up the major portion of the book.

In the second part, cutting operations are not strongly advocated except phlebotomy which is universally used. Trachoma was common and many operations for incurved eyelashes and adherent lids are described. Ranula is described and excision advised. Vesical stones are removed by lithotomy. Intestinal wounds are sutured with small threads derived from the intestinal coats. He is exceedingly cautious about high amputation. Arteries are ligated in continuity in wounds and different forms of suture are described. Obstetrics and its traumatic sequellæ are considered carefully. Extraction of arrows is taken up in detail and the forceps for their removal are illustrated.

In the third part, fractures and dislocations are discussed. Reduction is almost entirely manual and the machines, so popular later, are neither described nor illustrated. Various ointments are used to soften the parts before reduction. In dislocation of the shoulder he describes three types: the first and most common, an inferior dislocation; the second a dislocation inward toward the chest; and the third a dislocation upward. He further states that posterior dislocation cannot occur because of the scapula and anterior dislocation because of the nerves. It is interesting to note that the second method of reduction of dislocation of the shoulder advocated is the method of the heel in the axilla.

The translation from the Arabic into Latin was made by Gerhard of Cremona, born 1114, died 1187.

Albucasis

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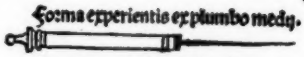

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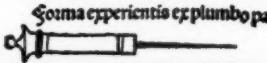

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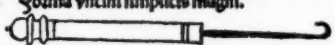

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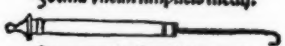

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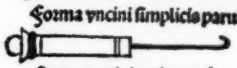

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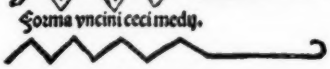

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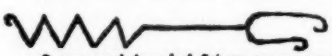

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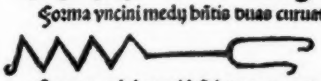

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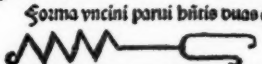

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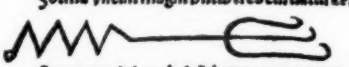

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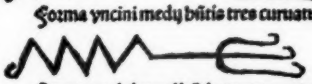

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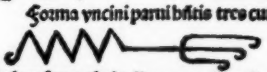

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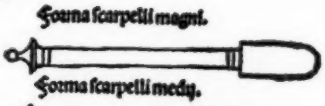

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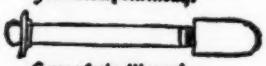

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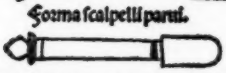

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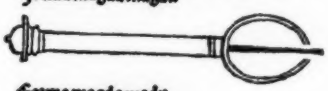

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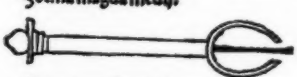

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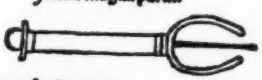

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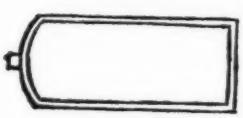

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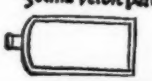

Forma spatumilis magni.

Forma spatumilis medij.

Forma spatumilis parui.

Siunt ex ere ꝛ sunt similia radio:cum quo fit alcobol:ꝛ in extremitate late est puncta spatumilis occultata:ꝛ in ea currit ad interiora:ꝛ ad exteriora quandoyis sicut vides. Forma spatumiliū que abscinduntur inter digitos apud perforationē apostematū:ꝛ non pelpiunt ea ifirmi:ꝛ sunt trium spērum magnū medium ꝛ paruū. Forma spatumili magni medij ꝛ parui rotundi cum extremitate puncte nunc dixi eos. Forma ventosarum cum quibus abscindi tur fluxus sanguinis ꝛ sunt trium specierū magne medie ꝛ parue. Fiant ex ere aut citrino rotunde ad longitudinez parūper sicut vides:ꝛ fiat ad subtilitatē ꝛ oportet vt fiat

REVIEWS OF NEW BOOKS IN GYNECOLOGY AND OBSTETRICS

By GEORGE GELLHORN, M.D., F.A.C.S., St. Louis, Missouri

THE publication of works, in which obstetrics and gynecology are treated conjointly, seems to me of the highest significance. Some 30 years ago Peter Mueller, of Berne, and a little later Schauta, of Vienna, attempted to encompass the two branches in a single volume but their endeavors received little encouragement. In 1914, Liepmann, of Berlin, conceived the idea of a pretentious work of a greater gynecology in which the two sister sciences would be represented in the same intimate connection which they occupy in actual life. Two volumes had appeared (and were reviewed in these pages[1]) when the war put an end to this undertaking as it did to so many other good things.

The idea, however, of the close union of obstetrics and gynecology in book lore was intrinsically too sound to die. In 1921, Fairbairn, of London, edited, with the help of numerous able collaborators, an imposing volume on obstetrics and gynecology, the excellence of which was recognized in a previous review.[2] And now two new works—one in German, the other in English—have appeared which will still further consolidate the unification of gynecology and obstetrics.

Halban, of Vienna, and Seitz, of Frankfurt, with a staff of seventy collaborators, have given their reference work the title of *Biology and Pathology of Woman*.[3] The editors point out in the preface that the pathologico-anatomical conception of disease with its accentuation of largely morphological changes, which until recently has held undisputed sway, has not been all-sufficient to explain satisfactorily the totality of morbid disturbances. A number of new factors claim attention. Serology and bacteriology were the first to be considered. Physiological research, particularly in the domain of endocrinology, followed. The rôle of constitution and heredity in the production of disease began to be more clearly recognized. The influence of the environment and the greater participation of women in industry added their quota; and, finally, the effect of purely psychic causes could not be ignored. It is true that a definite evaluation of all these various factors is as yet impossible, but this much is certain that *biological thinking* must henceforth be the basis of medicine. Applied to gynecology, this means that in the teaching and practice of gynecology not only the diseases of the female genital organs should be dealt with, but that everything should be considered which "from the moment of conception to the grave" may have an influence on the origin and treatment of these diseases. That obstetrics falls automatically into this scheme of biological conception requires no special comment.

The first three installments of this imposing work have thus far appeared in print. To enumerate their contents briefly, Halban discusses the general symptomatology and the principles of diagnosis in gynecology. The various forms and localizations of pain are carefully analyzed; enlargement of the abdomen and its different causes, abnormal bleeding, amenorrhœa, leucorrhœa, and symptoms pointing to the urinary organs compose the rest of this well-written chapter.

Polano contributes a beautifully illustrated section on methods of examination; the newer methods of pneumoperitoneum and tubal insufflation receive due attention.

Koehler supplies a discussion of 140 pages on medicinal, local, and organotherapeutic remedies. To us who have grown up in the surgical era of gynecology, it may seem on first thought that we need but very few drugs in practice; in reality, there is in actual use an enormous number of antiseptics, hæmostyptics, uterotonics, organic preparations, narcotics, aphrodisiacs and antaphrodisiacs, etc.; and the study of this chapter which furnishes details of the nature, indications, and effects of these various remedies proves highly profitable.

To Lindig has been entrusted the important subject of non-specific proteintherapy with its astounding possibilities of mobilizing the defensive apparatus of the organism.

Seitz adds a monographic dissertation of 174 pages on X-ray and radium treatment, profusely illustrated and reflecting the rich experience of this recognized authority on the subject.

The history of gynecology (and obstetrics) from its earliest prehistoric beginnings to the end of the 18th century has been written by Fischer and reveals on every page the thorough knowledge of the author. The contributions of every nation of the world, including China and Japan, are here recorded separately and in detail. It would have appeared preferable to me to follow up currents and developments through the ages, and though we might thereby have missed some of the details, we would have gained a clearer bird's-eye view of the vast material.

In the discussion of human embryology, Lubarsch has included the most recent additions to our knowledge.

The chapter on types and anomalies of constitution is from the authoritative pen of Mathes and is probably the last work that this well-known author wrote before his death. Associated with this chapter is a section on disturbances of nutrition and growth, by Guggisberg in which several of the manifestations of endocrine disorders (gigantism, dwarfism, castra-

[1] Surg., Gynec. & Obst., 1915, xxi, 400.

[2] Surg., Gynec. & Obst., 1922, xxxiv, 694.

[3] Biologie und Pathologie des Weibes. Ein Handbuch der Frauenheilkunde und Geburtshilfe. Edited by Josef Halban and Ludwig Seitz. Berlin and Vienna: Urban & Schwarzenberg, 1923.

tion, etc.) are discussed together with osteomalacia and chlorosis.

I wish I could stretch the space allotted to book reviews, to include selections from this monumental work which eventually will be completed in eight large volumes. The value of this "hand book" can not be overestimated. The names of the contributors who have not yet been heard from, but all of whom have made their mark in contemporary literature, guarantee that the future installments will be on a par with the excellence of the pages in hand. This is a work pre-eminently suited for the specialist. To the man engaged in actual practice of gynecology and obstetrics it is a reliable guide. To him who wishes to do research work, it represents an up-to-date reference work on all achievements of the subject. The exhaustive bibliographies at the end of each chapter predominantly, but by no means exclusively, of German literature, will be extremely useful to the student.

THE second book mentioned in the beginning, has been written by Kerr, Hendry, Ferguson, and Young, the former two of Glasgow, the last two of Edinburgh. Their *Combined Text-Book of Obstetrics and Gynæcology*[1] is addressed to the medical student and thus serves an entirely different purpose from that of the "Hand Book" reviewed above. In reality we have here two textbooks in one cover, with the emphasis laid on obstetrics to which more than 600 of the approximately 1000 pages are devoted. In looking through this combined textbook, one feels that the available space might have been divided more evenly. The chapter on examination, for instance, is much too brief and contains far too few illustrations. The discussion on ductless glands, likewise, might have been made longer in view of their decisive influence on the human economy. A subchapter on the total influence of pregnancy upon the maternal metabolism is intensely interesting. The methods of measuring the pelvis are described and depicted under the head of abnormalities of the bony pelvis. Would they not be more appropriate in the chapter on prenatal examination? The axis traction forceps is apparently much in favor with the authors to judge from the space and illustrations given to it. In closing the uterus after cæsarean section, catgut is not altogether relied upon and a number of through and through sutures of silk or linen are inserted for re-enforcement. In the gynecological part of the book the pathology and symptomatology of the various conditions is very well presented, but the discussion of treatment seems inadequately brief. In the matter of illustrations, the treatise does not attain the standard set by our own textbooks.

What, however, makes this work stand out among other textbooks, is the connecting chapter between obstetrics and gynecology. In this chapter in which a general review of the intimate relationships between the two departments is given, the student of gynecology is impressed with the importance of a thorough knowledge of obstetrics and with the fact that the great majority of ailments encountered in gynecological practice is the result of infections and injuries contracted during parturition. Sepsis and undue haste in delivery are the two main factors which must be avoided. Brusque and hurried expression of the placenta account for many cases of subsequent prolapse. Skilled obstetrical and gynecological knowledge is required in many problems of diagnosis. Among other examples the authors refer to the diagnosis of early and late pregnancy and its differentiation from various gynecological conditions such as hæmatometra, subinvolution, ovarian cyst, fibromyoma, distended bladder, pregnancy complicated by a co-existing tumor, ectopic gestation, hydramnios, pseudocyesis.

In thus emphasizing the indivisibility of gynecology and obstetrics, the authors, to my mind, have rendered a distinct service to the medical student and, indirectly, to womankind. Sporadic attempts to the contrary notwithstanding, the logical union of the two sciences is becoming more firmly established; and the time will come, let us hope, when separate departments of obstetrics and gynecology in schools will be a thing of the past and the true specialist will be an expert in "greater gynecology."

[1] A Combined Text-Book of Obstetrics and Gynæcology. By J. M. Munro Kerr, M.D., F.R.F.P. and S. (Glas.), James Haig Ferguson, M.D., F.R.C.S. (Edin.), James Young, D.S.O., M.D., F.R.C.S. (Edin.), James Hendry, M.A., B.Sc., M.B. Edinburgh: E. & S. Livingstone, 1923. American Distributors, New York: William Wood & Company.